THE

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MADE IN AMERICA.

IN our issues of October 11th and 18th, 1895, we published an illustrated description of the Bristol Electric Tramways and Power Station. It is unnecessary to refer here in detail to the manner in which the undertaking was carried out, or under whose advice the plant was selected and put in place. Suffice it to say that since the above dates important changes and developments have been made, or are on the verge of completion, especially in the power house.

When first opened, the station was fitted with three Willans centre-valve compound non-condensing engines; but these and the dynamos, full particulars of which can be seen in the numbers of the REVIEW before-mentioned, have, it is said, proved inadequate to cope with the increased service which has been demanded. Therefore, as was stated last week in a contemporary, this, and the fact that direct-driving is much more economical than the use of belts or ropes, methods of driving we may add to which Messrs. Willans and Robinson offered the most determined opposition from the very beginning, decided the tramway company to entirely replace the engines and dynamos by an up-to-date direct-driven plant. In designing and getting out a specification for the new equipment, Mr. H. F. Parshall was called in to advise; and the station, which is now nearly completed, in its way will be one of the finest in Europe.

Mr. Parshall, after very carefully—and, no doubt, impartially, although his position with the Thomson-Houston Company may give rise to the contrary belief,—considering the merits of all the various types of engines existing at the present moment, and which have been applied to traction purposes, decided to adopt the McIntosh and Seymour engine, an illustration of which, alongside a Willans engine, presumably of American build, can be seen in our other columns. According to our contemporary, it was decided to put in four 150 kw. direct-coupled sets, the engines used being horizontal. The diameter of the high pressure cylinder is 13 inches; that of the low pressure, 23 inches; stroke, 17 inches; revolutions, 200 per minute at 150 lbs. steam pressure. The economical load is 230 horse-power at one-third cut-off. At four-tenths cut-off the indicated horse-power is 310, the maximum cut-off being three-quarters. The total weight of the engine is 46,000 lbs. The weight of each fly-wheel is 4,500 lbs., the diameter being 82 inches. The diameter of the main steam pipe is 5 inches, and that of the exhaust 10 inches. All these engines are absolutely guaranteed to regulate from no load to full load within 2 per cent. variation of speed.

The question probably now agitating the minds of English engine makers who have devoted time, money, and experience to the development of prime movers suited to electrical requirements, is, why was it necessary to go to the

United States for new engines to put in the Bristol Tramways power station?

The readiest answer would probably be that, although we in Great Britain can produce steam motors eminently suited in all respects for the purpose of electric lighting, we have not had the necessary experience of the altogether different needs of electric traction, to be able to build an engine which can compete in all essential points with some of those turned out in the States, where electric traction has become common and its peculiarities amply provided for.

To those who have closely followed the slow and painful course of electric traction in England, hindered as it has been at every turn, the latest importation from America will be no surprise, for the McIntosh and Seymour Company have the reputation of knowing thoroughly well what they are about, and their productions are of first-class workmanship and highly successful; and it was most probably put by the advisers to the Bristol Tramway Company that when one comes to consider the engines which are available in this country, they are mostly out of the question on account of indifferent governing, a point about which there might have been some question, and want of fly-wheel power. One available type of engine is the slow-speed Corliss which governs perfectly, but this possibly was thought to take up too much space.

But are such arguments really sound? Are there not many English makers who could supply equally good, if not better engines, than these from the States, and if so, it is difficult to perceive any cogent reason why recourse should have been had to American manufactures. Of course, if it were proved that the machinery was being imported at a lower price, or that it was infinitely better, it would be an unanswerable reason for leaving English plant severely alone, but we understand on good authority that this is not so, and that English engineers, many of whom have been in competition on various occasions, can compete on favourable terms and at remunerative prices so far as this point is concerned.

There can, of course, be no objection to the introduction of American machinery into English markets if it meets a demand which we cannot supply; indeed, we should welcome such with open arms. As a matter of fact, we are deeply indebted to the skill of American engineers in designing a number of the machine tools which have led to vast improvements in many of our important industrial operations, and we do not forget that the Westinghouse brake, which has become part and parcel of so many of our railway systems, and which has so often shown its wonderful powers of preventing disastrous collisions, is of trans-Atlantic origin.

But was it in this case imperative to seek aid from abroad? We know of one English engineering firm which recently supplied two engines of 400 H.P. each to a tramway station in the Colonies, and is now engaged in executing the order for a third, although the dynamos and electric light plant were obtained from the States.

We know of another now building engines combined with medium speed continuous current fly-wheel generators placed in the centre of two engines, so as to get enormous storage fly-wheel power, more perhaps than has ever yet been attained on any combination built, and which, in the least possible space, will fulfil all the requirements of electric traction.

Then again, if the Willans engine, as manufactured by Messrs. Bullock, is as good as the McIntosh and Seymour motor—and from the description we give on another page there seems but little to choose between them—surely it is also available here?

There is but little doubt that those who were responsible for the selection of the Willans engines did not grasp the ultimate conditions of the Bristol tramlines, and the horse-power put down was therefore quite inadequate, but that does not show this particular type of engine to be unsuited to traction needs; it goes rather to prove that the Tramway Company had not gained that experience without which a redesigning of the whole plant was bound to arise.

Are not the Hartlepool, Stockwell, and Liége tramway engines giving every satisfaction? And have not other English engines done equally well at Coventry and the Isle of Man?

We know that the American makers in question have produced for the contractors here a number of similar engines, and that they have everything cut and dried to suit each size of dynamo, the demand in the States having been very large for some years, but if English engine builders are not allowed to try what they are able to do, how can the home manufactured article be put in at all in any of the electric traction schemes of the future? The chance for English engineers under these circumstances seems extremely small. Everyone knows that it is difficult enough to get work here in England in competition with the free imports of all other countries, and as America takes nothing from us in this line, our manufacturers doubtless think this ought to be the last country in the world from which such a large quantity of plant should be imported. But on this side of the water the electric tramway engineer of the present day has yet to gain a thorough knowledge of his newly acquired duties, and he, therefore, looks to the country whose experience he can make use of and whose plans he can utilise with the likelihood of achieving success and earning fame and fortune for himself at the same time. Who can blame him?

The Americans have the pull of us in all matters concerning electric traction, a pull that will require some years to make up; therefore, it is perhaps only natural to seek American aid, but it is, all the same, rather rough on English engine builders.

It is rumoured that the Bristol Corporation is highly desirous that the power for the tramcars should be taken from the electric light supply, and that this extension of the tramway power-house is a counterblast on the part of the contractors, but whatever may be the moving spirit which has given rise to this curious episode in the history of electric traction in Great Britain, it seems certain that unless some little feeling for home manufactures is encouraged the chances for home builders seem poor, for there is evidently a determined effort being made by our trans-Atlantic cousins and their European representatives to secure as much traction business as possible in England and on the Continent.

THE SEAT OF THE ELECTROMOTIVE FORCE.

Mr. Swinburne is an inveterate paradoxer. In his recent Cantor Lectures he discusses the well worn subject of the seat of the electromotive force in the voltaic cell. He has undoubtedly succeeded in throwing a good deal of new darkness on the subject. We have studied his theory as Faust did theology, with a wet towel round our head, and we find we

are as wise as ever. He says (ELECTRICAL REVIEW, p. 477): "But let us carry the idea of a cyclic potential to a cell with two terminals, connected by two pieces of wire to, say, a resistance which, in comparison with that of the rest of the circuit, we can consider infinite. Consider a unit quantity of electricity at the positive terminal of the cell. Suppose the cell gives 1 volt. Call the potential at the positive terminal anything, say 100. Follow the charge along the resistant part of the circuit. It does work and falls 1 volt, and gets to the negative terminal. The negative terminal is therefore at 99 volts. Seekers after the seat of the electromotive force seem to assume that if the charge goes on through the cell to the positive terminal, the potential there will be 100 again; but it will only be 99. The potential of the terminals differs by a volt, if considered as connected by the resistance; but they are at the same potential considered as connected through the cell. If the charge were raised 1 volt on its way through the cell, the line integral of the electric force round the circuit would be zero, and the cell could do no external work." No doubt we shall become a convert to this new doctrine when we understand it. At present it looks to us as if Mr. Swinburne expects, after rushing down a hill on his bicycle with his brake on, to get back to the top by some by-path of no resistance, without putting his feet on the pedals. A motor car will run round a level circular track lap after lap till its store of energy is exhausted; but if the motor is disconnected and the car is propelled round a downhill track by gravity, it can go round once only, and will find itself at a lower level when it arrives at the point it started from. If this analogy is correct, the continuous rotation of a live conductor in a magnetic field does not necessarily imply a fall of potential along its track.

Analogies, we admit, are dangerous guides on a question like this, because we know hardly anything for certain about the constitution either of matter or of the ether, and therefore cannot determine how the energy travels in the electric circuit. We quite sympathise with Mr. Swinburne in his fling (in the pages of a contemporary) at the "cock certainty" of some of our scientific teachers on electrical theory. Dr. Lodge, in criticising Mr. Swinburne's views on the seat of the electromotive force, thinks that the whole subject is satisfactorily explained by the pump analogy. Mr. Swinburne replies: "It seems to me a matter of definition. If you define the seat of the electromotive force as the place where energy enters the electric circuit, then the place where energy enters the electric circuit is the seat of the electromotive force. It needs no pump analogies to make that clear. If Dr. Lodge supposes I mean that the energy given out as heat at a resistant part of the circuit is not paid for by chemical heat, or mechanical energy, he has misunderstood me. Even if it has all decayed, except a definition skeleton, I don't want to exhume Dr. Lodge's seat of electromotive force from consecrated ground merely to rebury it at cross-purposes roads with a mistake through it."

Mr. Swinburne's heterodoxy is healthy, and although his doctrine that "there is not any" seat of the electromotive force only illustrates the natural tendency of scepticism to go to extremes, it will do good by preventing us from settling down into a comfortable faith in pump analogies. Faith, however indispensable it may be in theology, should have no place in science. As to the exact location of the E.M.F., we prefer till we have received more light, to remain an agnostic.

The Pender Memorial.

WE congratulate the Executive Committee on their recommendation to those who elected them, to make the memorial a strictly personal one. There seems to be no objection that we can see to such a course, for the services of Sir John Pender to the cause of telegraphic extension were very remarkable and deserve to be duly commemorated, especially by those companies and individuals, here and abroad, with whom he was associated. Previously there appeared to be a disposition on the part of some to select certain names for a general memorial to celebrate the inception and extension of submarine telegraphy. This, from its very exclusiveness, and perhaps for other reasons, must have produced considerable irritation, if, indeed, it did not detract greatly from the honours they would have thrust on some to the unjust omission of others. There are certain names of pioneers indelibly written in the history of the subject, and to omit these names from a general memorial would have courted failure, and at the same time have rendered absurd the selection made. Now, however, if the resolutions passed at the Executive Committee Meeting are confirmed by the General Committee the way will be cleared for avoiding the wayward, if not somewhat ignoble, position into which the matter might have drifted.

Wet Superheated Steam.

SOME recent experiments by M. Dwelshauvers Dery have shown an apparent economy to arise when superheated steam is used in conjunction with drain taps on an engine valve chest. Disregarding for a moment the possibility of there being water in a superheated chest, we pass at once to the remarks of the *Engineer*, which has been furnished with some notes by Mr. Bryan Donkin, jun., upon the strength of which our contemporary jubilantly expresses its opinion that this is but another proof of the inexplicable action of steam in an engine. Steam is said to be superheated when its temperature rises above that proper to its pressure, water being freely in contact. As a fact steam does not become dry until it has received several degrees of nominal superheat. Steam is only truly superheated when its expansion ceases to be excessively rapid as Fairbairn found was the case, for the first few additional degrees of temperature above that of generation. Now, M. Dery, if we are to take Mr. Donkin's abstraction to be correct, has shown it to be a mistake to drain a steam chest when using steam of nominally 72° superheat. This was shown in some experiments; other experiments showed just the reverse, but more so. We cannot be serious. Our contemporary can, and always is, ponderously so, when a mares nest is found. Only let an experiment with some rough engine appear to contradict some natural law and Norfolk Street is stirred in its depths, and one of the now familiar leaders is thundered forth. As to the quality of the superheated steam which allowed water to exist in the valve chest we forbear an opinion. There is nothing to lead one to suppose such a thing is possible. When will amateur writers cease to take a few experimentally determined figures as a basis for doubt. We do not suppose that M. Dery intended any such weight to be placed on his experiments. There is absolutely nothing conclusive about the figures abstracted for the *Engineer*, and the remarks as to the combined steam of Wethered are absolutely inane and entirely beside the point. What Wethered did was perfectly correct. He added superheat by means of a small supply of exceedingly hot steam injected amongst the larger body of steam in the main steam pipe, and he called the mixture "stame." Calling it "stame" did not alter the fact that the fluid was, after all, only ordinary superheated steam, and in no way differed by reason of its mode of manufacture, which was done for convenience alone. But Wethered has no monopoly of the word "stame." We have heard the word across St. George's Channel applied to the ordinary saturated stuff. It really is too bad of the Norfolk Street thunderer to trot out so much verbiage on so trivial a pretext. However inexplicable to the *Engineer*, we do not think engineers will accept such fatuous conclusions from a few experiments.

COMMUTATOR BRUSHES FOR DYNAMO-ELECTRIC MACHINES, THEIR SELECTION, THEIR PROPER CONTACT AREA AND THEIR BEST TENSION.*

By ALFRED E. WIENER, E.E., M.E., M.A.I.E.E.

(*Concluded from page* 551.)

3. *Energy Loss in Collecting Armature Current. Determination of Best Brush Tension.*—The brushes give rise to two losses of energy: An *electrical* energy loss, due to overcoming contact resistance, and a *mechanical* loss, caused by friction. Both of these losses depend upon the pressure with which the brushes are resting upon the commutator, the electrical loss decreasing and the mechanical loss increasing with increasing brush-tension. There will, therefore, in every single case, be one certain pressure per unit area of brush contact, for which the sum of the brush losses will be a minimum. With the object of determining this critical pressure, E. V. Cox and H. W. Buck† have investigated the influence of the brush tension upon the contact resistance and upon the friction, for various kinds of brushes. They found (1) that the friction increases in direct proportion with the tension; (2) that the contact resistance decreases at first very rapidly, but that beyond a certain point a great increase in pressure produces only a slight diminution of resistance; (3) that slightly oiling the contact surface, while not perceptibly increasing the electrical resistance, greatly diminishes the friction; (4) that for a copper brush the friction is greater and the contact resistance smaller than for a carbon brush of the same area at the same pressure; (5) that the friction of a radial carbon brush is greater than that of a tangential carbon brush at the same pressure; (6) that for the same brush both the contact resistance and the friction are considerably less on a cast iron cylinder than on a commutator, and (7) that for all kinds of brushes the friction is less at high than at low peripheral speeds, while the contact resistance is but slightly increased by raising the velocity.

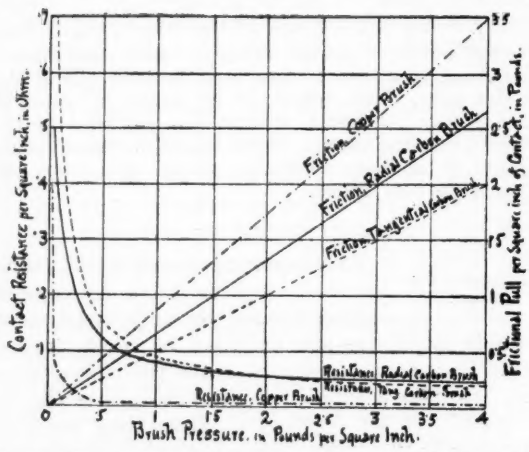

Contact Resistance per Square Inch, in Ohms.
Frictional Pull per Square Inch of Cont.ct, in Pounds.
Brush Pressure, in Pounds per Square Inch.
Friction, Copper Brush
Friction, Radial Carbon Brush
Friction, Tangential Carbon Brush
Resistance, Radial Carbon Brush
Resistance, Tang. Carbon Brush
Resistance, Copper Brush

Fig. 10.—Contact Resistance and Friction per Square Inch of Brush Surface on Copper Commutator (Dry) at Peripheral Velocity of 1,000 Feet per Minute.

In figs. 10 and 11 the averages of their results are plotted, the former giving the curves of contact resistance and friction for an ordinary commutator without lubrication, and the latter the corresponding curves for the case that the commutator is replaced by a cast iron cylinder.

From fig. 10 the following table is derived which, in addition to the data obtained from the curves, also contains the brush friction for the case that the commutator is slightly oiled.

The specific pull, f, due to brush friction, in columns 6 to 10 of the following table is given for a peripheral velocity of 1,000 feet per minute; at 2,000 feet per minute it is $\frac{7}{8}$; at 3,000 per minute, $\frac{3}{4}$; at 4,000 feet per minute, $\frac{5}{8}$, and at 5,000 feet per minute only $\frac{1}{2}$ of what it is for that pressure at 1,000 feet per minute; and for any commutator velocity, v, can be found from the formula:

$$f' = f\left(1 - \frac{v - 1{,}000}{8{,}000}\right). \qquad (5)$$

From the following table the electrical brush loss is calculated by dividing the contact resistance given for the particular brush tension employed by the contact area and multiplying the quotient by the number of sets of brushes and by the square of the current passing through each set, thus:

$$P = 2p \times \frac{r}{A} \times \left[\frac{C}{p}\right]^2 = 2 \times \frac{r \times C^2}{A \times p} \text{ watts}$$

$$= \cdot00268 \times \frac{r \times C^2}{A \times p} \text{ horse-power}, \qquad (6)$$

Contact Resistance and Friction for Different Brush Tensions.

Brush tension in pounds per square inch.	Contact resistance per square inch of brush surface, r, in ohms.			Tangential pull due to brush friction per square inch of contact at peripheral speed of 1,000 feet per minute, f, in pounds.					
				Commutator dry.			Commutator oiled.		
	Tangential copper leaf brush.	Tangential carbon brush.	Radial carbon brush.	Tangential copper brush.	Tangential carbon brush.	Radial carbon brush.	Tangential copper brush.	Tangential carbon brush.	Radial carbon brush.
·5	·010	·50	·40	·6	·3	·5	·16	·10	·15
1	·009	·24	·20	1·15	·63	1	·32	·20	·30
1·5	·008	·15	·13	1·7	·95	1·5	·48	·30	·45
2	·007	·12	·10	2·25	1·25	2	·64	·40	·60
2·5	·006	·10	·037	2·8	1·6	2·5	·80	·50	·75
3	·0055	·09	·08	3·4	1·9	3	·96	·60	·90
3·5	·0052	·083	·075	3·95	2·2	3·5	1·12	·70	1·05
4	·005	·03	·07	4·5	2·5	4	1·30	·80	1·20

where P = energy absorbed by contact resistance of brushes in H.P.;

r = resistivity of brush contact, in ohm per square inch surface, from table;

A = contact area of one set of brushes, in square inches; $A = b \times l$;

p = number of pairs of brush sets;

C = current output of dynamo.

And the frictional loss is obtained by multiplying the tangential pull, given for the respective brush tension, and corrected to the proper peripheral velocity according to formula (5), by the total brush contact area and by the peripheral velocity of the commutator, and dividing the

* *The American Electrician.*

† "The Relation Between Pressure, Electrical Resistance and Friction in Brush Contact," Electrical Engineering Thesis, Columbia College, by E. V. Cox and H. W. Buck. *Electrical Engineer*, Vol. xx., p. 125 (August 7th, 1895); *Electrical World*, Vol. xxvi., p. 217 (August 24th, 1895).

product by 33,000, the equivalent of one horse-power in foot-pounds per minute:

$$P_1 = \frac{f' \times 2p \times A \times v}{33{,}000}$$
$$= 6 \times 10^5 \times f' \times A \times p \times v \text{ H.P.}, \quad (7)$$

in which P_1 = Energy absorbed by brush friction in H.P.

f' = specific tangential pull, due to friction, at velocity v, in lbs.; see formula (5);

$2pA$ = total area of brush contact surfaces in square inches;

v = peripheral velocity of commutator in feet per minute,

$= \frac{d \times \pi}{12} \times s$ (d = diameter of commutator, in inches, s = speed of dynamo in revolutions per minute.)

By calculating the amounts of P and P_1, from (6) and (7), respectively, for various trial brush tensions, the best tension giving a minimum value of the total brush loss, $P + P_1$ can readily be found.

For the machine considered in the example above the best brush-tension is calculated as follows:—Supposing an armature speed of $s = 900$ r. p. m., the peripheral velocity of the commutator is found

$$v = \frac{10 \times 3{\cdot}14}{12} \times 900 = 2{,}360 \text{ ft. p. m.}$$

and therefore from (5)

$$f' = \left[1 - \frac{23{,}600 - 1{,}000}{8{,}000} \times\right] f = {\cdot}83\, f.$$

For $p = 1$ pair of brush sets, $c = 150$ amps. and $A = \frac{5}{8} \times 8 = 5$ square inches; we now compute the total power absorbed by the brushes at various tensions. For a pressure

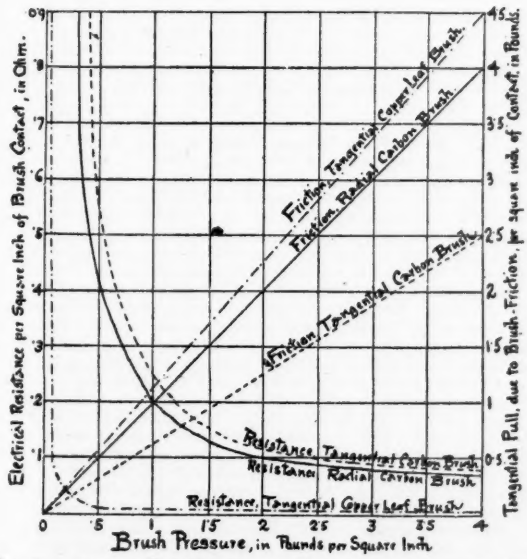

Electrical Resistance per Square Inch of Brush Contact, in Ohm.
Tangential Pull, due to Brush-Friction, per square inch of Contact, in Pounds.
Brush Pressure, in Pounds per Square Inch
Friction, Tangential Copper Leaf Brush.
Friction, Radial Carbon Brush.
Friction, Tangential Carbon Brush.
Resistance, Tangential Carbon Brush.
Resistance, Radial Carbon Brush.
Resistance, Tangential Copper Leaf Brush.

Fig. 11.—Contact Resistance and Friction per Square Inch of Brush Surface on Cast-Iron Cylinder.

of 1 lb. per square inch the table gives $r = {\cdot}24$ ohm and $f = {\cdot}63$ lb. when the commutator is dry. Correcting the latter figure for the proper velocity we obtain $f' = {\cdot}83 \times {\cdot}63 = {\cdot}523$ lb. From formula (6), consequently, the power absorbed by contact resistance is found

$$P = {\cdot}00268 \times \frac{{\cdot}24 \times 150^2}{5 \times 1} = 12{\cdot}05 \times {\cdot}24 = 2{\cdot}89 \text{ H.P.}$$

while formula (7) gives the power consumed by friction:

$$P_1 = 6 \times 10^{-5} \times {\cdot}523 \times 5 \times 1 \times 2{,}360 = {\cdot}708 \times {\cdot}523 = {\cdot}37 \text{ H.P.}$$

Hence the total power used for collecting the current, at a brush-tension of 1 lb. per square inch of brush contact surface:

$$P + P_1 = 2{\cdot}89 + {\cdot}37 = 3{\cdot}26 \text{ H.P.}$$

For 2 lbs. per square inch, $r = {\cdot}12$ and $f = 1{\cdot}25$, or $f' = {\cdot}83 \times 1{\cdot}25 = 1{\cdot}04$; consequently:

$P = 12{\cdot}05 \times {\cdot}12 = 1{\cdot}45$ H.P.
$P_1 = {\cdot}708 \times 1{\cdot}04 = {\cdot}74$ H.P.
$P + P_1 = 1{\cdot}45 + {\cdot}74 = 2{\cdot}19$ H.P.

Similarly, for $2\frac{1}{2}$ lbs. per square inch, $r = {\cdot}10$, $f = 1{\cdot}6$, $f' = {\cdot}83 \times 1{\cdot}6 = 1{\cdot}33$.

$P = 12{\cdot}05 \times {\cdot}10 = 1{\cdot}205$ H.P.
$P_1 = .708 \times 1{\cdot}33 = {\cdot}94$ H.P.
$P + P_1 = 1{\cdot}205 + {\cdot}94 = 2{\cdot}145$ H.P.

And for 3 lbs. per square inch, $r = {\cdot}09$, $f = 1{\cdot}9$, $f' = {\cdot}83 \times 1{\cdot}9 = 1{\cdot}58$.

$P = 12{\cdot}05 \times {\cdot}09 = 1{\cdot}085$ H.P.
$P_1 = {\cdot}708 \times 1{\cdot}58 = 1{\cdot}12$ H.P.
$P + P_1 = 1{\cdot}085 + 1{\cdot}12 = 2{\cdot}205$ H.P.

The total power here being observed to increase again, $2\frac{1}{2}$ lbs. per square inch, producing the minimum value of $P + P_1$, is found to be the best brush tension, if no lubrication is used.

If oil is to be applied to the commutator the values of f_1 P_1, and $(P + P_1)$ are as follows:

For the tension of 2 lbs. per square inch: $f = {\cdot}4$,
$P_1 = {\cdot}708 \times {\cdot}83 \times {\cdot}4 = {\cdot}588 \times {\cdot}4 = {\cdot}235$ H.P.
$P + P_1 = 1{\cdot}45 + {\cdot}235 = 1{\cdot}685$ H.P.

For 3 lbs. per square inch: $f = {\cdot}6$,
$P_1 = {\cdot}588 \times {\cdot}6 = {\cdot}35$ H.P.
$P + P_1 = 1{\cdot}085 + {\cdot}35 = 1{\cdot}435$ H.P.

For 3·5 lbs. per square inch: $r = {\cdot}083$, $f = {\cdot}7$,
$P = 12{\cdot}05 \times {\cdot}083 = 1{\cdot}00$ H.P.
$P_1 = {\cdot}588 \times {\cdot}7 = 41$ H.P.
$P + P_1 = 1{\cdot}00 + {\cdot}41 = 1{\cdot}41$ H.P.

For 4 lbs. per square inch: $r = {\cdot}08$, $f = 8$,
$P = 12{\cdot}05 \times {\cdot}08 = {\cdot}964$ H.P.
$P_1 = {\cdot}588 \times {\cdot}8 = {\cdot}47$ H.P.
$P + P_1 = {\cdot}964 + {\cdot}47 = 1{\cdot}434$ H.P.

In this case the minimum value of the total power indicates that $3\frac{1}{2}$ lbs. per square inch is the most economic brush tension.

. . . . . .

If the commutator brushes of dynamo-electric machines are designed in accordance with the above considerations, the heating of commutator and brushes will be small, the energy losses of commutation will be reduced to a minimum, and the sparking will be limited—the fundamental conditions for excellence in performance.

THE POSSIBLE AND THE IMPOSSIBLE IN ELECTRIC DEVELOPMENT.

All are familiar with the layman who, having read some silly statement in some other person's weekly, founded on ignorance and developed on lines of sheer nonsense, persists in putting forth his views on the subject in question. He does so in happy ignorance of the most elementary knowledge. A German friend, whose chief delight is the running down of things English, and the crowing up of the "highly educated German," lately had this craze badly developed. He had read somewhere of a system of toughening glass, and at once predicted its use for lattice girders, nor would he, or could he see, that however much toughened, glass could not be used to form a tension member. Mr. W. Baxter deals with this phase of impracticable ignorance in the *Engineering Magazine*. He truly says that the amount of knowledge now possessed of science in general enables us to locate the dividing line between the theoretical possible and impossible, but not between the practically possible and impossible. There is so wide a margin between the theoretical and the practical, that we cannot draw the line of practical limits.

Practical success in a theoretically possible direction is largely a question of materials and arrangement, and a better knowledge of materials, coupled with repeated trials and long experience, will always widen the field of practice and bring practice nearer to theory. The uninstructed layman never grasps the limits. He knows, perhaps, what a large power

there is in fuel regarded simply on the basis of heat units generated, and he tells you how small a proportion of the total heat is got out of fuel by the steam engine in the form of work. It is no use trying to argue with him or tell him of absolute temperatures. He has got figures which you are bound to admit are truthful, and he argues from these to suit himself.

Mr. Baxter instances the storage battery as one of the things that is supposed to be capable of great improvement. The storage battery is known to have theoretical possibilities of great range, for the actual weight of material which *acts* in a storage battery is only about 12 lbs. per H.P. hour of energy stored, or only one-tenth the weight of batteries. Now, it is not an unreasonable thing to expect that a battery might be brought down to about double the minimum theoretical weight and so on, the qualities of the battery being approached to theoretical limits. But there always remains the unknown element of practical possibility especially in regard to internal resistance and discharge rate. The primary battery using coal that is so much talked about and expected to send the steam engine to the scrap heap is, in a certain sense possible, but there are mountains of practical obstacles to be overcome in its perfecting. At present all batteries consume portions of their own structure, and in this sense resemble a steam boiler, of which the furnace bars form the fuel. If a coal battery is ever to be a success, it will certainly not be in such a form that the coal is placed like the zinc of the ordinary battery. To be a success it would be necessary to have the power of feeding in coal as into a furnace. Given this difficult point satisfactorily solved and the primary battery would even then be perhaps too bulky to displace steam plant except for stationary purposes. In all systems of lighting similar facts confront us. Even the arc light only gives at most 10 per cent. output for a given energy supplied. The incandescent light is but a two per cent. affair. Gas light is even of worse showing. Theory points to the possible conversion of energy into a larger proportion of light and less heat. Practice, so far, is far behind theory. In fact all through the wide domain of science and its applications we are not ignorant of the limits in which we can move. We generally know how far short we are of an efficiency of 100 per cent., and we are not likely to seek for more than this efficiency. The difficulty is to approach anything at all near to it. In whatever direction we look we find that the production of energy or its setting free from the latent state is a difficult matter. Whether it be power or light that we seek, only a small percentage of what we know to be there can be secured. In producing light, for example, we get a very small result as light and we get a quantity of heat in addition. The transmission of energy, when once we have got the energy, is comparatively easy. Thus we find a large proportion of the brake H.P. of a steam engine can be recovered as brake H.P. on the spindle of an electric motor through two processes of conversion. Similarly, with the power in falling water, which can be recovered as brake H.P. at the turbine shaft with a few per cent. loss only. But we cannot recover the latent solar heat from coal except as heat. To convert the heat into power baffles us except for a small percentage. Science tells us our limits even here, and men are not carried away by Keely and his kind if they will only listen to what experience and knowledge can tell them. It is just ignorance of these things on the part of laymen that makes them a prey of the unprincipled.

REVIEW.

The Mineral Industry: Its Statistics, Technology, and Trade in the United States and other Countries to the end of 1895. Edited by Richard P. Rothwell. New York and London: The Scientific Publishing Company, 1896.

This is an attempt, and we should say a very successful one, to give full statistics and a general review of its subject. The subject is a very wide one, and is made to embrace the chemical trade likewise. The whole volume is exceedingly well got up, and every care seems to have been taken in getting up information. It is not merely a directory of mineral statistics, but to a fair extent a descriptive treatise on the mode of producing and treating many of the minerals described, and the various productions of many countries, being in many cases stated over a series of years; this enables the progress and development of different countries to be compared. The large growth in the German chemical trade forms the subject of an article by one Lunge, and, being a German, he takes the usual opportunity so dear to the Teutonic mind of venting his spite upon England. Articles breathing so distinct an animus disfigure a book of this sort, and though Mr. Rothwell himself is very Anglophobic, we are surprised he allows it. Considering the very great area of the United States, it is also curious that when making up statistics with the vein of spread-eagleism running through every page, the editor should not compare American production with the production for a similar area, say that of all Europe. We should expect to find comparisons of that order. Yet Americans never seem to acquire a mind of the breadth one would expect from a dweller in continents. The area of the United States is infinitely greater than that of any country in Europe, yet Mr. Rothwell seriously compares American production of all kinds with that of little European countries like Germany or France or England. He does not dream of taking Europe as his unit of comparison, which would be more reasonable. We consider in a work of this description that the figures ought to speak for themselves, and the statistics of manufacture in the United States are quite sufficiently striking in their growth and magnitude for this to be done. The utilisation of the natural bounties of America make one regret that our race and people have not obtained a foothold on portions of the globe perhaps fully as well stocked as America and with equally good climates, which are now trodden only by the yellow man or the Tartar.

There is really an immense amount of information in the compass of these 800 pages, and Mr. Rothwell is to be congratulated on the production of so valuable a book, which will remain a credit to his industry when his Anglophobia and bimetallism are happily forgotten.

ENGINE BREAKDOWNS.

The last report of the Engine, Boiler, and Employers' Liability Insurance Company lies before us, and, like its predecessors, contains some excellent information and deductions of value from the experience of the company in breakdowns. Out of 129 total breakdowns of insured engines, 26 per cent cannot be classified as to cause, because the extent of disaster has been so general as to involve the whole engine in ruin, and thus the first cause is hidden. A similar percentage was due to negligence. 31 per cent. arose from causes of faulty design or construction, and 17 per cent. from old defects, wear and tear. As shown by previous experience spur gearing and valve gearing are fruitful causes of breakdowns. In Mr. Longridge's excellent report of a few years ago, he drew special attention to the unnecessary and useless length of teeth in mill gearings. A tooth three-quarters the pitch in length is out of all reason, and yet these ridiculous proportions still find their way into text books and are followed by the majority of makers. The very maximum of length should not exceed half the pitch. This proportion has been used for some years by the writer for pitches as small as 1 inch, and has been the cause of a good deal of amusement to him in the exceeding perturbation of mind that sets in amongst fossilised and rut-bound men who dare not leave the beaten track in things mechanical even though that path be strewn with wreckage. Mr. Longridge, for large wheels, showed how an actual length of about $\frac{3}{8}$ths inch was enough for pitches of something like 4 inches; and we are certain that for large pitches teeth very much less than half a pitch in length are amply long. With short teeth play or room for back lash can be reduced to a minimum, and the mischievous friction which occurs when long teeth are approaching the line of centres is avoided. It is also pointed out that there is danger in putting gearing before heavy rope-driving. If done, the fly-wheel ought to be heavy, and the rope velocity low, while there is apt to be danger where the period of vibration of the ropes synchronises with the revolution of the engine. As regards the relative velocity of the fly-wheel and of the ropes, the advice of Mr. Longridge is practically that of the old millwrights that the peripheral speed of the fly-wheel should be greater than that of the millstones, or back lash will result. We are also of opinion that with horizontal or other direct acting engines spur gears are far more strained in work than where they are driven by a beam engine.

It is, however, very largely from the weakness of rod ends and such details as gibs and straps that breakdowns arise. One would almost have thought the open ended strap held by a gib had become extinct, but it seems they are still made and continue to fail under the heavy lateral stresses put on them by the inertia of the moving parts, the tendency being to open the jaws of the straps. Locomotive rods always have their straps secured by stout bolts while, where possible, ends are made solid. Mr. Longridge

lays stress on the danger of the open strap. He also directs attention to the folly of rings in an air pump bucket. When it is thought that an air pump bucket of vertical action has a water packing on top and reciprocates 60 to 100 times a minute in ordinary mill engines, it is palpably ridiculous to introduce such complications as rings. Why not use a plain bucket as Mr. Longridge suggests, or at most one with several square grooves, ¼ inch by ¼ inch. Air pump rings of brass cut and wear very rapidly, and Mr. Longridge rightly terms them an absurdity. In a vertical pump the wear of a bucket need be only very small; the bucket simply floats up and down, and need not be made to press upon the barrel. The amount of water passing by an easy fitted solid bucket is next to nothing, and no fear of a vitiated vacuum need be entertained for a moment, for there is always water over the bucket. We have known numerous split air pumps to be caused by the jamming of worn out rings. Before the so-called metallic bucket was brought out as an improvement, the buckets of air pumps were usually packed with pieces of spruce jammed into a groove about 4 inches by 1 inch, turned in a solid bucket. The wood was turned up true when dry and swelled to a tight fit, and wore away as it swelled until it became an easy but close fit in the pump barrel. These wooden packed buckets gave the best of results, and the writer has used many of them and never found a modern metallic bucket to give any better results though they cost a great deal more. But metallic buckets became fashionable, and were chiefly useful—like cross tubes in boilers—to help sales and not to serve any economic or useful purpose.

CITY AND GUILDS OF LONDON INSTITUTE.

The report on the work of the Examinations Department of this Institute, which has recently been issued, is interesting reading and may be studied with advantage by all technical teachers, as it shows that there is a good deal to be learnt by the teachers and directors of instruction as to the proper way in which technical education should be carried out. Not for the first time by any means are great complaints made of the extremely bad quality of the sketches and diagrams in the answers given by the candidates in the papers set. Year after year is the same complaint made but nothing seems to be done to mend matters in this respect. The report of the examiner in electric lighting and power in addition to his remarks on the badness of the drawings, draws attention to the unreal nature of the information possessed by the candidates, and from the parrot knowledge which so largely does duty for an acquaintance with the subject. This point is further exemplified by the examiner in telegraphy and telephony, who states that a question which was set as a test of general education was answered incorrectly in almost every case. The conclusion, says the electric lighting and power examiner, is that in many cases the teachers who are conducting the classes are not engineers at all, but possess only a book knowledge of electrical work. Although the foregoing remarks have special reference to training in electrical subjects the same apply with equal force to many others, thus, as regards "Gas Manufacture," the examiner says, "the answers indicate an absence of an all-round training in connection with the subject." The examiner in "Photography" says, "the candidates show a complete want of general photographic knowledge." Many other examples could be given in the same direction. Some more satisfactory tests of the competence of teachers seems to be required if proper teaching is to be obtained.

As regards the general progress of the Examinations Department, the report is very satisfactory in regard to numbers, the total of students attending at classes registered by the Institute being 29,494 as compared with 27,583 in the previous year, and the number of candidate's papers examined was 12,099. The number of prizes awarded was 240 against 233 in 1895. An examination was held this year for the first time in electric wireman's work. It was open to candidates who had passed the preliminary examination in electric lighting. It consisted of the jointing and insulating of bell wire and of pieces of electric lighting cable of different pressures. Of the 219 candidates who were eligible for the practical test, 44 presented themselves and 34 passed. The examination was held in London and at 11 other centres.

ENGINES FOR ELECTRIC RAILWAY SERVICE.

In the *American Electrician* for last month, there is a lengthy article on the subject of steam engines for electric railway service, no less than 15 types being illustrated. *Apropos* of the Bristol Electric Tramways, we select the two following:—

Fig 1 shows a horizontal, tandem-compound, direct connected railway engine made by McIntosh, Seymour & Co.

Gridiron valves are used on both high and low pressure cylinders, and the clearance is reduced to a minimum, it being claimed to amount to only about one-half the clearance on Corliss engines of the same stroke. The valve gear is positively driven and admits of any speed, the same valve gear being used on engines running at 60 r. p. m., 100 r. p. m., 200 r. p. m., or 300 r. p. m. This valve gear is controlled at every point by the governor, and prevents any possible running away of the engine under any condition of load or any condition of change in load.

The makers claim as a great advantage the fact that the valves are unbalanced, and therefore wear tight, since with most existing forms of valve gear, including the Corliss, the wear renders the valve leaky, causing an increasing loss of economy. At the same time, they state, the valves are easily driven, as they are only in motion when the ports are open and are at rest when the ports are closed, so that the valve gear on the largest engines can be easily handled with the full steam pressure on. The admission valves are double, and move in opposite directions when opening and closing, so that a full opening or closing is obtained with a very slight movement of the valve itself; in a 1,000-H P. engine the distance is only about 1¼ inches. The method of taking hold of the valve gear by the eccentric is such

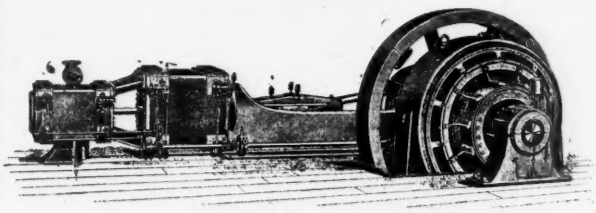


Fig. 1.

that angularity is corrected, for there is the same movement of the valve for both ends of the stroke, and for all loads. The governor controls the cut-off both in the high and low pressure cylinders, so that the division of load and the fall in temperature in the high and low pressure cylinders are equalised for all loads.

Between the high and low pressure cylinders a long babbitted sleeve is provided in which the piston rod runs. This serves both as a packing tube, doing away with glands and the constant trouble incident to packing them, and as a long bearing guiding the pistons, keeping them central in the cylinders, and thus avoiding the wear and tear upon the ordinary type of construction. Both ends of the high and low pressure cylinders are provided with automatic relief valves of the pop safety valve type, which serve both as relief valves and as drip valves. Where desired, the high pressure cylinder is steam jacketed, and a receiver of large capacity is provided between the high and low pressure cylinders, this receiver containing coils filled with steam at boiler pressure, thus serving to dry the steam before it passes into the low pressure cylinder.

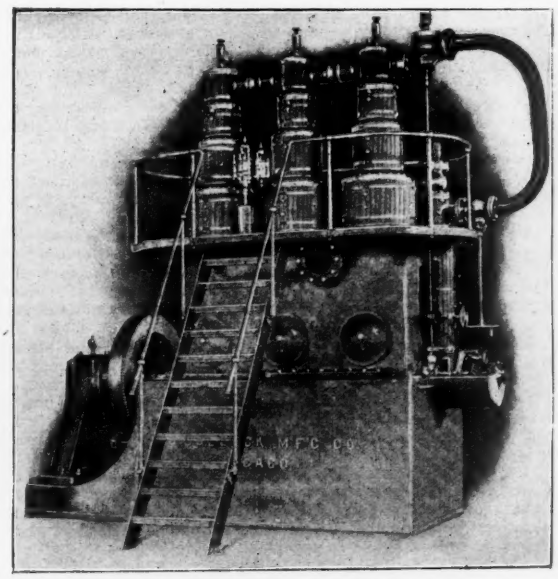


Fig. 2.

All parts of the engine are made to gauge and interchangeable, flat surfaces are scraped to surface plates, and surface and cylindrical grinding used where advantageous. The framing is heavy and massive, stiffened with internal ribbing, and the material so placed that the strains act in a direct manner. The frame below the guides is carried right down to the foundation so that the strains are transmitted direct from the crosshead through the frame to the foundation, and not through the bolts holding the cylinder to the framing.

The makers of this engine are now building a three-cylinder, triple-expansion engine, to be direct connected to a 500 kw. railway generator at 120 revolutions.

Fig. 2 shows a Willans central valve engine of the heavy duty type, manufactured by the M. C. Bullock Manufacturing Company, which is especially designed for electric street railway work, the ratio of the cylinders and the cut-off being arranged for an extremely large economical range of load. The automatic cut-off is of the relay type, and consequently the governor is small, quick-acting, and has prac-

tically no wear, while the power to move the cut-off valves is practically unlimited. The makers claim that the engine is quite capable of withstanding any shock due to all conditions of load without the introduction of couplings, and that short-circuiting does not affect the engine injuriously in any way, while the load can be thrown off or on as suddenly as is possible. An economy is claimed for this type of engine even exceeding the results of similar sized slow-speed or Corliss engine units. The compactness of the combination is undeniably of great value where real estate or buildings are at all costly. The high speed of the engine enables smaller generators to be used, and it can be run continuously for months without shutting down, the system of lubrication throughout being entirely automatic. The makers state that on the compound engine, condensing, a steam economy of less than 15 lbs. has been obtained, and on the triple expansion engines figures as low as 12½ lbs. of water per I.H.P. per hour have been recorded under suitable conditions.

LEGAL.

Andrews & Co. *v.* Ullathorn.

In the Court of Queen's Bench on Monday, Mr. Justice Collins, sitting for the trial of commercial causes, concluded the hearing of the case of Andrews & Co. *v.* Ullathorn, which was an action between electrical engineers for goods supplied. Mr. Hohler was for the plaintiffs, and Mr. Tindal Atkinson, Q.C., and Mr. Scott Fox for defendants.

Mr. Hohler said the plaintiffs were electrical engineers and manufacturers at Victoria Street, Westminster, and defendants were electrical engineers, of Charles Street, Bradford. In the month of September, 1894, Messrs. Marshall, Kaye & Marshall, of the Oaklands Mill, Ravensthorpe, near Dewsbury, were inviting tenders for a contract for carrying out an electrical installation. The specifications required the use of goods and appliances manufactured by the plaintiffs, and the defendants proposed sending in a tender. Before doing so they obtained price lists and catalogues from the plaintiffs, showing the goods which they had in stock, and which, after defendants had obtained the contract, they were instructed to supply. Plaintiffs also agreed to send a competent and efficient foreman to superintend and assist in the execution of the contract, defendants agreeing to pay his wages. The amount plaintiffs now claimed, certain payments having been made, was £493.

Mr. J. Piper, head of the plaintiffs' firm gave evidence in support of the claim. He said he agreed to supply a special kind of lamps and fittings, and parts of apparatus only manufactured by his firm. The contract was for concentric wiring, a system in which all the pendants unscrewed and were movable. He described at length the parts and fittings which had been supplied. They were only supplied by his firm, which possessed the patent rights. The prices charged were in accordance with their price lists. Defendants said there were certain overcharges, but there was never any objection raised until they pressed for payment.

In cross-examination, he admitted that there had been delay, owing to his premises having been destroyed by fire. He also admitted the receipt of frequent letters from the defendants, complaining in very strong terms of the delay in supplying the articles ordered.

Mr. Tindal Atkinson admitted that the goods had been supplied to the defendants, who had paid £150 prior to the issue of the writ. They had since paid £173 into Court, and they counter-claimed £154 damages by delay in the execution of the orders, which had rendered defendants liable to penalties under their contract, and £29 overcharges.

Mr. Ullathorn, the defendant, and another member of his firm were examined at length as to the delay caused by the non-execution of orders within a reasonable time, and His Lordship having expressed surprise that such a case should have been sent to him for trial, said he was amazed at the effrontery of the plaintiffs in bringing the action, after having admittedly been guilty of such gross delay in the execution of orders. It seemed to him that the counter-claim was a substantial one, and together with the sum paid into Court, was sufficient to wipe out any balance which could possibly be paid. He therefore gave judgment for the defendants both on the claim and counter-claim, and refused Mr. Hohler's application to stay execution with a view to an appeal.

CORRESPONDENCE.

"Electricity in Mines."

I notice a letter from Mr. H. W. Appleby in reply to mine of October 2nd. He says he thinks the efficiency, as given by Mr. Kennedy, of compressed air plants is too high, but he does not give any reason for the want of faith which is in him.

If he will refer to page 235 of the excellent work upon "Transmission of Power," by Prof. Unwin, F.R.S., he will find, when speaking of the experiments on air motors by Profs. Riedler and Gutermuth, these words:—"The efficiency is, therefore, 0·81, an extremely good result," the air being heated to 300° F.

He will also find on page 240, "that is to say, the efficiency of the whole arrangement, compressor, main, and air motor, when the air is used cold, ranges from 44 to 51 per cent., and that with mains of quite moderate size."

If I am wrong, therefore, I err in very good company.

I am not content to accept what he calls "the usual working conditions." We are talking of what is the actual possibility in each case, and not what headless individuals in charge of mines choose to make it, because they won't take the trouble to cool it in the compressor, and keep their joints tight.

He, and your readers, must remember that when dealing with districts in a mine where safety lamps are used, everything has to be watched with the strictness of a powder magazine, and the use of compressed air is, therefore, calculated to relieve the anxiety and responsibility of the mine manager.

I am very pleased to hear of the success of electric coal-cutting; for handiness and adaptability to circumstances, no other means of transmission of power is equal to it.

With respect to the plant for lighting, to which I referred, not being an electrician, I cannot give him much description of it. The figures are not mine, but were sent me, as I said, from the head offices, having been taken from the wages and stores books. It included lighting at the shaft bottom and stables, screens, shops, and engine houses at bank, and 7½ per cent. on the capital.

A. L. Steavenson.

Precipitation of Gold from Cyanide Solutions.

I have just seen the article in your issue of October 16th, dealing with the precipitation of gold from cyanide solutions by electricity. With some of your remarks I cordially agree. Like you, I do not approve of exposing plain iron anodes to cyanide solution, and I do not see that a method for the recovery of gold which involves the fusion and cupellation of a large bulk of lead, is the best possible. In the patent of mine to which you refer, No. 16,634 of 1895, I have specified means which I believe will yield satisfactory results in economy, in time, and labour, as compared with methods in which plain iron anodes and plain lead cathodes are used. I do not, however, recommend any electrical method in preference to zinc. Many people have an exaggerated idea of the power and economy of electrical action, and are best pleased when they can make electricity useful. To such people my patent above referred to appeals, but I do not recommend it in preference to zinc, and the assumption that the zinc method has been repudiated, abandoned, and condemned by me, is quite erroneous.

It was generally understood that the Siemens-Halske method of precipitation was discarded at the Metropolitan Mine and the George Goch, because it was not a success, and no other reason has yet been suggested.

Kindly give this letter same publicity in your Journal as you have the supposed abandonment of zinc on my part.

John S. MacArthur.

Glasgow, *November 2nd.*

Preserving Meat by Means of Electricity.

Referring to the note on page 571 of your issue of 30th ult., the following is an extract from the "Memoirs of Andrew Crosse,"* bearing on the above subject. The experiments were made a considerable time before 1855, the year in which Mr. Crosse died:—

"*Electrification of Water, Wines, Spirits, Meat, &c.*—Mr. Crosse directed his attention to the purification of sea water and other fluids by electricity. In acting on sea water, it is necessary to submit it to one distillation, a process which only renders it fit for washing, but not for drinking. A very simple electrical arrangement is then applied to the cask or cistern of sea water, and in 24 hours or less the water becomes perfectly wholesome to the taste, and will remain sweet in open vessels for an indefinite time. The mode of electrisation is curiously simple. Two cylinders of dissimilar metals (generally sheet zinc and sheet iron), are placed in two porous

* Published by Longman, Brown, Green, Longmans & Roberts, London, 1857.

earthenware tubes, open at the top, and closed at the bottom. The metallic cylinders being connected together by a copper riband, the porous tubes, with the metals inverted in them, are filled with water, and placed in the fluid required to be purified. The electrical action immediately commences, and the fluid not only becomes purified, but is rendered antiseptic in a few hours.

"The application of this principle to wines and brandy has been attended with great success. It has the effect of softening the asperities of some wines by removing the predominance of bitartrate of potash, and in the case of the spirit distilled in imitation of French brandy, the improvement to be derived from using the process is remarkable." In one experiment two gallons of the very worst English brandy were kept electrified for three weeks; at the end of the time the spirit was drawn off infinitely improved, indeed, visibly purified, for the water in the positive porous tube had become intensely acid, and the negative tube was filled with a green oleaginous fluid, thick and turbid.

"This process has also been applied most effectually to stopping the fermentation in cider, and also in other things, such as starch. Brackish water is also wonderfully purified by this arrangement. (This application of the electric principle has also been patented by a company of gentlemen.)

"The antiseptic power of electrified water is very remarkable. Not only can it be preserved for years perfectly clear and fresh, but it has the power of restoring the most putrid substances to sweetness. Pieces of meat, and the skins of animals in a state of putridity, have been immersed in electrified water, and in a few hours rendered inodorous. Milk has also been kept sweet for three weeks in the middle of summer by the application of electricity. On one occasion Mr. Crosse kept a pair of soles under the electric action for three months, and at the end of that time they were sent to a friend, whose domestics knew nothing of the experiment. Before the cook dressed them, her master asked her whether she thought they were fresh, as he had some doubts. She replied that she was sure they were fresh; indeed, she said she could swear that they were alive yesterday! When served at table they appeared like ordinary fish, but when the family attempted to eat them they were found to be perfectly tasteless; the electric action had taken away all the essential oil, leaving the fish unfit for food. However, the process is exceedingly useful for keeping fish, meat, &c., fresh and good, for 10 days or a fortnight."

F. T. J. Haynes.

Taunton, *October 31st*, 1896.

Hermite and Others against The British Electrozone Corporation, Limited.

The electrical Press having noted the institution of this action, we shall be obliged for the equal courtesy of your publication of the fact that the action has been dismissed on plaintiffs' own initiative.

The British Electrozone Corporation, Limited,
John A. Barham, *Managing Director.*

Information Wanted.

I take the liberty of asking you to inform me as to the electrical propulsion of carts for the removal of night soil and street refuse. Any information you may give as to what has been done in this way, and the makers of the plant, would be esteemed a favour.

Chas. C. Lindsay.

The Clydebank Battery.

Having seen a report in the *Ironmonger* of September 26th *re* primary batteries, and which report I quote from here, will you kindly give us your opinion as to the value of the same. I would just say we are interested in the autocar driven by electric power.

Quotation.

McDonald Bros.' Electric Motor Car, Strathtay, Scotland.

There are 20 of the patent cells used on the car, and of these 15 are carried underneath the seat, five in a case carried in front. The great points claimed in favour of these cells are that they are cheap to manufacture; sold at a low figure; cheap to work and not heavy; one charge will last 15 hours, and nothing but salt and water used for re-charging; the cost of running 100 miles, 2s. 9d.; carrying two passengers comfortably.

Primary Battery.

[Our correspondent will find our opinion of the Clydebank primary battery given in the Electrical Review for February 15th, 1895 (p. 199), and February 22nd, 1895 (p. 235).—Eds. Elec. Rev.]

BUSINESS NOTICES.

Electrical Wares Exported.

Week Ending Nov. 3rd, 1895.	£	s.	Week Ending Nov. 3rd, 1896.	£	s.
Adelaide	300	0	Alexandria. Telep. mtl.	34	0
Alexandria	183	0	Amsterdam	108	0
Algoa Bay	16	0	Antwerp...	118	0
Amsterdam	50	0	Batoum. Teleg. mtl....	50	0
Antwerp	219	0	Bombay	8	0
Bombay	306	0	Boulogne	13	0
Boulogne	9	0	Calcutta	46	0
Brisbane	41	0	Cape Town	216	0
Buenos Ayres	800	0	Colombo...	40	0
Calcutta...	9	0	Constantinople	261	0
„ Teleg. mtl. ...	57	0	Durban	50	0
East London	152	0	Flushing	25	0
Fremantle	90	0	Fremantle	820	0
Grenada	7	0	Launceston	146	0
„ Telep. mtl. ...	38	0	Malta	14	0
Hong Kong	27	0	„ Teleg. mtl. ...	301	0
Lisbon	40	0	Mauritius	8	0
„ Telephone mtl. ...	20	0	Melbourne	79	0
Melbourne	122	0	„ Teleg. mtl.	340	0
„ Teleg. mtl. ...	765	0	Port Darwin	10	0
St. Lucia	80	0	Riga	16	0
St. Petersburg	800	0	Rosario	267	0
„ Teleg mtl. ...	60	0	Rotterdam	46	0
Stetten. Teleg. mtl. ...	782	0	„ Teleg. cable ...	29	0
Sydney	289	0	Singapore. Teleg. mtl....	20	0
Westeras Teleg. mtl. ...	111	0	Sydney	486	0
Yokohama	100	0			
Total	£5,473	0	Total	£3,551	0

Foreign Goods Transhipped.

Gibraltar	64	0
Total	£64	0

A New Lampholder.—Messrs. Evered & Co., Limited, are introducing the n.p. lampholders for B.C. incandescence lamps. The cases of the holders are fitted with patent insulators, which are so devised that a short circuit is said to be impossible. The terminals are of special construction, and the springs of plated steel wire. All the parts are interchangeable, and can be used for suspension or screwing on, by using either the china grips or the screw nozzle with the same holder. The holders are arranged to facilitate wiring operations.

Bankruptcy Proceedings.—At the London Bankruptcy Court, last Tuesday, the first meeting of creditors was held under the failure of Meyner, Handford & Co., electrical engineers, &c., of James Street, Westminster, and Brighton Works, Redhill. The electrical branch of the business was started by Mr. Meyner at the end of 1886, and in August, 1894, Mr. Handford became a partner by adding the branch of builders' merchants. The debtors have not filed any accounts, but they roughly estimate their liabilities at £3,000 and their assets at £1,800. The latter item includes a claim against Mr. Parkhurst for £418, balance due on contract for the installation of the electric light and other work done at 42 and 44, James Street, Westminster, and another claim for £45 from Mr. H. T. Bluett under a contract for electric light installation at Manhattan Mansions, Holloway Road. The failure is attributed to bad debts, losses on contracts, excessive interests charged on borrowed money, law costs, and other causes. The meeting was adjourned for three weeks to allow the debtors to lodge an offer for the payment of a composition to the creditors.

British Insulated Wire Company v. Fowler-Waring Cables Company.—This action was mentioned to Mr. Justice Kekewich in the Court of Chancery on Wednesday, when counsel for the plaintiffs said he had agreed with counsel for the defendants (who assented to this statement) upon terms which would render unnecessary his Lordship's dealing with the case.

Business Announcement.—The business of Geo. Richards & Co., Limited, Atlantic Works, Broadheath, near Manchester, manufacturers of high class machine tools, wood working machinery, pulleys and line shaft fittings, which was advertised for sale some time since as a going concern, has recently been sold by private treaty, and will shortly change hands. The business will be carried on as heretofore under the name of Richards & Co., Limited,

who will continue the manufacture of the firm's specialities. We understand that they have been exceedingly busy in all branches for the past 12 months.

Change of Address.—Messrs. Mavor & Coulson have acquired property at Glasgow lately belonging to Messrs. Clark & Co., Mile End Thread Works, and have moved their establishment to new offices. Messrs. Mavor & Coulson are proceeding with the building of a large new shop, with special plant for the construction of electrical machinery.

The registered offices of the Manchester Edison-Swan Company, Limited, are now situate in Victoria Street (Exchange Station Approach), Manchester.

Curtis Bros.—This firm of electrical engineers, &c., of Suffolk Street, Dublin, inform us that, owing to business extensions, arrangements are at present in progress for increasing their capital, and amalgamating their business with another firm in Dublin, and it is expected matters will very shortly be completed.

Electrical Accessories.—Messrs. Heaton, Smith & Co.' of Salford, Manchester, have just issued an illustrated catalogue, consisting of about 80 pages, in which are described the numerous electrical accessories made by them. A thick enamelled paper has been used, and in consequence the many small blocks print to advantage. The firm make a speciality of switches. Main switches, single and double-pole, "Triumph," H. & S. patent, flat type two-way, Brush type, resistance switch for starting motors, &c., and tumbler switches for high tension work, lamp-holders, ceiling roses, electric light brackets, pendants, ship and mill fittings, and a large variety of other accessories are given. Toward the end of the book is some useful tabulated information regarding conductors, fuse wires, and resistances.

Failure in Supply.—At St. Peter's, Cranley Gardens, last Sunday, the electric light, which had been installed for three weeks, went out while a harvest festival service was in progress.

Gas.—A serious gas explosion on 28th ult. at London Road, Southwark, was attended with the usual results, *i.e.*, wreckage and personal injury.

Newcastle Exhibition, 1897.—Arrangements are now actively in progress at Newcastle-on-Tyne for the opening there in February next of an Electrical and Engineering Exhibition, which, among other purposes, is, as already stated in these columns, to commemorate the 60th year of the Queen's reign. It is proposed to illustrate the changes and developments that have taken place in electrical, engineering, and other leading branches of industry since 1837; but the promoters will also do what is possible to make the building and its surroundings attractive as a place of public resort. In the first division of the exhibits there will be departments for electricity, shipbuilding, and sea industries, machinery and products, self-propelled conveyances, and machinery. Division II. will comprise education and instruction; science and chemistry; furniture and accessories; sanitation, medicine, hygiene, and public relief; heating, lighting, and ventilation; textile fabrics, &c.; alimentary products; horticulture; women's industries, and the fine arts. As there are only three months before the exhibition is to open, we should think, if it is to be a thoroughly representative concern, complete information should be immediately forthcoming.

The Jandus Arc Lamp.—The Jandus arc lamp is apparently about to be introduced into Belgium, for a company has just been registered in Brussels with a capital of £40,000, to be known as La Compagnie Continentale Jandus d'Electricité.

The London Health Electrical Institute.—A petition for winding up this company was, on October 27th, presented to the Court by R. O. Hearson, Limited, creditors of the company. The petition will be heard at the Law Courts on November 11th. Mr. A. Arnold Hannay, 54 and 55, Chancery Lane, E.C., is the solicitor for the petitioner.

"The Quiver."—The first part of the enlarged series (new volume) for November is full of interesting and instructive matter from the pens of prominent writers. It is accompanied by a presentation picture by Ary Scheffer. The article on "Fighting the Fire Demon," which is illustrated by several photographs showing firemen at drill, is especially attractive.

X Rays.—An illustrated catalogue of electrical supplies for "X" ray photography has been issued by Mr. F. C. Allsop. Spark coils, focus tubes, batteries, screens, &c., are shown and priced.

Yost Typewriters.—The Yost Typewriter Company has just been awarded a gold medal by the Dantzic Exhibition Committee, this making the 12th gold medal the company has received within recent years.

ELECTRIC LIGHTING NOTES.

Aberdeen.—Messrs. John Fleming & Co., Limited, propose to light their premises on both sides of Market Street by electricity, and for this purpose have requested permission to lay a cable under and across Market Street. The Council has granted permission conditionally.

The £9,336 scheme for the electric lighting of the harbour quays, &c, for the Harbour Board has been under consideration by the Gas and Electric Lighting Committee, which now recommends the Council to adopt the report of the city electrical engineer and the harbour engineer. It is also recommended that in the event of its being also adopted by the Harbour Commissioners, the Council should execute the works devolving on them as described in the report, on the Commissioners entering into an arrangement with the Council to receive and pay for an annual supply of electrical energy of not less than 80,000 units; that in such event the charge for the supply of electrical energy should be at the rate from time to time fixed by the Town Council, and charged to consumers, but subject to a discount of 20 per cent. on the amount supplied; that in calculating such discount the Commissioners should be entitled to credit for the amount of electrical energy consumed by the owners or occupiers of such premises along the harbour quays as may be supplied from the mains to be laid by the Town Council under the arrangement proposed, it being understood, however, that such consumption by the owners and occupiers of premises shall only be reckoned for the calculation of discount while and so long as the consumption by the Commissioners is less than 80,000 units; it being further understood that such owners and occupiers shall not be entitled to any proportion of the discount.

The Gas and Electric Lighting Committee have agreed to erect a new water superheater for the boilers at the electric lighting station, the estimated cost being £400.

Barking.—At the recent Council meeting, it was decided to put an end to the present system of illuminating the streets by oil lamps, and try something more modern. Gas will be considered, but before anything is done, Mr. W. C. C. Hawtayne is to be asked to draw up a report on electric lighting.

Bath.—Mr. Tulloch held a Local Government Board inquiry into the application of the City Council for power to borrow £58,000 for electric lighting.

Christ Church is to be fitted up for electric lighting, a member of the congregation having lent £250, free of interest, for the purpose.

Bangor.—Mr. W. H. Preece, C.B., F.R.S., lectured at the New Hall of the North Wales University College on Friday on "Electric Lighting."

Belfast.—The Electric Committee's report on the question of extensions was before the Council the other day. They recommend the stoneyard in Laganbank Road as a suitable site for the new station. The mover of the resolution to extend the system (Councillor Andrews) said that the present station has a capacity of about 17,100 lamps, and they had applications for 17,145. Of course, there was a stand-bye of 20 per cent., and they also estimated that only 65 per cent. of the lamps wired would be running at one time. For the first 11 months there was a small surplus of £373, and he believed that for the past year they would be able to show about £2,000 of revenue which will be applicable to the payment of interest or depreciation, or other purpose; in other words, after keeping the plant up in good condition, they would have enough money to pay interest to the Gas Committee for the loans from the date they were granted. He believed when they had a good steam driven station, the city of Belfast would not lose any money in the electric light venture. The money that would be wanted for the new station would be about £50,000. Councillor Andrews said that his answer was exceeding simple. It would be a financial catastrophe to have a large gas-driven station as a central station, and Prof. Kennedy's idea was that the present gas-driven station would be a subsidiary one when the steam-driven station was erected. The new scheme was absolutely following out the lines of the original scheme of Prof. Kennedy. An amendment deleting the reference to the new site was passed.

Bradford.—The Town Council has resolved that the area for electricity supply, described under Schedule A of the Bradford Corporation Electric Lighting Order of 1883, should be enlarged, so as to include those portions of the borough which were shown upon a plan lying for inspection in the Town Clerk's office, and to include all buildings and houses on either side of the streets indicated.

Brighouse.—The Town Council, at a special meeting, unanimously decided to apply to the Board of Trade for a provisional order.

Brighton—The Insurance Question.—At a meeting of the Brighton Town Council last week, it was stated that the Lighting Committee originally paid 2s. 6d. per £100 for the insurance of the electricity station. This was afterwards increased to 5s.; but now the insurance companies, having confederated, had decided to charge all generating stations 10s. 6d. per £100 on buildings, and 21s. per £100 on dynamos. The Lighting Committee (Councillor Stafford proceeded) determined to resist this enormous charge, and decided that it would be better for them to form a reserve fund, and become their own insurers. The Committee were then informed that the insurance companies would reconsider their decision, and they accordingly decided to insure for three months only at increased rate, so that if a reduction was not made in the charges, the Committee would be free to do as they liked. The Committee had taken every precaution to make the station fireproof, and had spent £1,000 above the ordinary contract for that purpose. They had arranged to have hydrants placed all over the building, and the employés were to be drilled in the use of the fire appliances. If, in addition to the reserve fund, they put away the £225 they were now to be charged, they would soon have a very large fund for their own use. Mr. Stafford referred to the large sums paid by the Corporation for insurances and for fire prevention, and said that during the existence of the Corporation they had never made any claim on the insurance companies, showing how infinitesimal, with all their precautions, was

the chance of fire. He suggested that the General Purposes Committee should consider the advisability of establishing a fire insurance fund. After several members had expressed concurrence in Councillor Stafford's views, the action of the Lighting Committee was confirmed.

At the Council meeting last week, it was stated that the electricity works have this year yielded £2,000, which will go towards the rates.

Chagford.—A Devonshire paper says that the Parish Council has accepted Mr. Reed's tender to light the town electrically for £2 per lamp per annum.

Church Lighting.—The electric light has just been substituted for gas in the Church of Our Lady of the Rosary, Marylebone Road.

Colombo.—The electric light is gradually being introduced into Government establishments, and the Colombo Customs are to be lit with the light. Messrs. Boustead Brothers have secured the contract, and, says *Indian Engineering*, "their workmen are hurrying on with the preliminaries, boring holes through the massive walls for introducing the necessary plant."

Cork.—The question of lighting the workhouse is under the Board of Guardians' consideration. A report is to be prepared.

Dublin.—The Electric Lighting Committee have issued a report giving an account of the working of the electric light undertaking for 1894 and 1895, what has been done in the present year, and what it is proposed to do in the future. The committee state that the gross income for the year 1895 was £11,073 13s. 5d., and the expenditure charged against same has been £7,939, leaving a surplus of revenue over expenditure to the extent of £3,134 13s. 5d. They go on to say: "This surplus has been carried to the Net Revenue Account, and after providing for £1,679 2s. 11d. interest, £500 for depreciation account, and for amounts written off assets shown in last accounts, a sum of £873 17s. 7d. is available towards meeting the charge of £2,213 6s. 8d. for repayment of loans, the balance of which, viz, £1,339 9s. 1d. has been discharged through rates accounts. The charge for interest on and repayments of loans was £681 1s. in excess of that for the previous year, and the balance to debit of net revenue accounts, being excess of expenditure over income for the year 1895, has been £1,339 9s. 1d., the debit balance brought forward from the year 1894 being £1,615 6s. 1d., making the total debit against net revenue account £2,954 15s. 2d. The latter sum has been provided for out of the rates assessed in the years 1891 and 1892, the balance to credit of rates account on December 31st, 1895, being £1,805 9s. 6d. On December 31st, 1895, the sum of £1,000 charged against net revenue account stood to credit in the depreciation account, having been invested in 2¾ per cent. Consols. The capital account shows that the total amount received on account of loans up to December 31st, 1895, has been £52,000, the expenditure on capital account to the same date being £53,164 13s. 10d. The amount not yet taken up on account on loans which have been sanctioned by the Municipal Council and by the Local Government Board, after inquiries, is £9,400, and the amount remaining due on December 31st, 1895, on account of £52,000 loans received, was £46,320. The Electric Lighting Committee look forward to the future with confidence. There are increasing demands for electric lighting from the citizens, and at present there are close on 150 applications before the committee, which they are unable to satisfy. They are confident that when they are able to establish an enlarged electrical power station at the Pigeon House Fort (the present station is altogether too small to meet the increased public demand for electric lighting), they will be able to supply a magnificent installation for the public lighting of the entire city, as well as for a large number of private consumers. "The Committee being advised that the Pigeon House Fort will be in the possession of the Corporation within three months or so, they are desirous, with the sanction of the Council, of obtaining an adequate loan from the Local Government Board for the purpose of establishing at the Fort, or some other approvable site, a new and enlarged site."

St. Francis Xavier's Church, Upper Gardiner Street, Dublin, is being fitted up with an electric lighting installation, which is approaching completion. The spacious cellars at the rear of the church are being adapted and utilised for engine, dynamo, and battery rooms. The motive power will be supplied by a 10 H.P. (nominal) gas engine. The electrical storage battery consists of accumulators which will be capable, when fully charged, of supplying 100 lamps of 16 candle-power each for 10 hours. The battery will also be used for starting the engine. Messrs. Edmundson & Co. are carrying out the installation.

Ealing.—The surveyor has reported that the number of 8 C.P. lamps applied for is 9,160.

Edinburgh.—A proposal to light Haymarket Terrace as far west as Magdala Crescent by electricity was before the Town Council last week. A scheme for this extension will be brought up at the beginning of the next financial year.

Electric Lighting of Steel Works.—Some new works, known as the West Lothian Steel Rolling Mills, also the offices connected therewith, are to be lighted by electricity, this contract being in the hands of Messrs. Hunter & Jack, Glasgow.

Fareham.—Last week Mr. F. H. Tulloch, M.I.C.E., held an official inquiry respecting an application of the Urban District Council to borrow £1,900 for electric lighting purposes. It is now desired to lay additional mains underground, and to provide duplicates of the engines and plant at the electric light station. Applications from private consumers had increased, and the residents were waiting for the additional work to be carried out before the light could be supplied to them. It was stated that the engines and plant it is proposed to purchase are second hand.

Fermoy.—Mr. F. Warden-Stevens, electrical engineer, submitted an agreement for the consideration of the Commissioners, to be entered into between them and the company to be formed for the purpose of lighting the town with electricity. A special meeting of the Board was arranged to consider the subject. The Government is in treaty with the same company for the lighting of the two military barracks in Fermoy, and also the new camp at Kilworth.

Gorton.—The District Council has resolved to apply for power to supply electricity in the district for lighting and other purposes, and to appoint a committee to take into consideration the advisability of supplying the district with gas of its own manufacture, or by a local authority other than the Corporation of Manchester.

Grantown.—A scheme for lighting this town by electricity, waters of the river being utilised to provide the necessary power, has been reported upon by Messrs. Stewart & Co., Limited, of Glasgow. This report favours the use of a 70-H.P. Achilles reaction horizontal turbine. Plant sufficient for the equivalent of 2,000 8-C.P. incandescent lamps.

Hampstead.—The Lighting Committee recommends the Vestry to light High Street and Haverstock Hill, to the boundary of St. Pancras parish, with electric arc lamps.

Islington.—The Finance Committee's report, which was adopted by the London County Council, recommended the Council to lend the Islington Vestry £24,000 to defray the cost of an installation of electric lighting in the parish. The Vestry asked for £31,000, but the Committee, being of opinion that the remainder was for work which ought to be paid for out of revenue, recommended that only the sum stated should be sent.

Kingston.—The salary of the Borough Electrical Engineer (Mr. Edgcome) was under consideration at the last Town Council meeting, the General Purposes Committee having recommended an increase from £200 to £250, making, with £50 as advising engineer in respect of the sewage works, £300 per annum. The voting was 12 in favour, and 13 against, therefore the motion was lost.

Lambeth.—With reference to the proposed transfer of the provisional order obtained by the Vestry to Mr. C. W. Sax, a letter has been received from the Board of Trade pointing out certain objections to the transfer of the order to an individual. It was resolved to send a copy of the communication to Mr. Sax for his observations. A Committee was appointed to consider the Board of Trade's letter and Mr. Sax's reply, and report to the Vestry thereon.

Leyton.—Prof. Robinson's recommendation to lay down additional plant (including a gas producer, two engines and dynamos, and an extra set of batteries), and erect a battery room, the total cost being about £3,000, has been adopted. These extensions are necessary immediately, on account of the great demand for current.

The Tradesmen's Association has decided to send a deputation to the District Council, asking whether the Council could not come to some arrangement for supplying tradesmen with fittings at a reasonable price, and also to make inquiries respecting the cost of the light.

Lisburn (Ireland).—The Town Commissioners have been making (through the Streets Committee) inquiries *re* electric lighting.

London (St. George's).—The Vestry has consented to the application being made by the County of London Brush Electric Lighting Company for a provisional order for lighting the parish by electricity.

Manchester.—The City Council has resolved to oppose applications being made for provisional orders for lighting districts adjoining the city by electricity. The Council will endeavour to come to some arrangements in the matter with the local authorities of those places.

Arc lamps are to be placed in Albert Square, St. Ann's Square, and Piccadilly, current to be charged for at 2d. per unit.

The lighting of public clocks by electricity is under consideration by the Town Hall Committee.

Newington.—The Vestry is giving the London Electric Supply Corporation notice that it intends to apply for a provisional order. The question of making application to the Board of Trade will, however, be discussed by the Vestry on November 28th.

Paris.—It is stated that the British Embassy in Paris is being permanently fitted with electric light.

Poole.—The Council has resolved to give its consent to an application being made by the Bournemouth District Electric Supply Company for a provisional order for supplying electricity within the borough.

Southampton.—The Electric Lighting Committee recently recommended the Council to advertise for tenders as soon as the consulting engineer was prepared with specifications, &c., for extending the mains down certain streets. They further recommended that after the March quarter the maximum charge for the supply of electric light be reduced from 7d. to 6d. per unit, and that the charge to the Harbour Board and other consumers for motive power be reduced from 6d. to 3d. per unit after the Christmas quarter. The committee's report was adopted.

Stirling.—On 26th ult. Prof. Kennedy visited Stirling, accompanied by Mr. Mackenzie, convener of the Lighting Committee of Edinburgh Town Council. In company of the Electric Lighting Committee of the Commissioners, Mr. Mackenzie made a tour of the town and suburbs, and in the afternoon met the Commissioners in a body. The proceedings were private, but it is understood that Prof. Kennedy's opinion was that Stirling, from its situation near the coal-fields, and its other advantages, was peculiarly well adapted for the introduction of the electric light, with a good prospect of success.

Stockton.—The Tees Conservancy Commissioners had before them, on 2nd inst., a proposal to light the graving dock by electricity. The chairman of the Graving Dock Committee (Mr. William Hanson), referring to this, said that they had reduced the firms tendering to two, but they thought it would be very desirable if, instead of confining themselves merely to the electric light, they went further, and erected electric motors for the convenience of the customers using the dock who might desire to apply the power to their machinery there. It would mean the erection of a more powerful dynamo than was contemplated by the report on the minutes, and he asked that the consideration of the report should be deferred for another month, so that they might seek advice on the subject. This was agreed to.

St. Pancras.—Increasing demands for electric current necessitate a separate main, extending from Cleveland Street to Gower Street, Euston Road, and another along the north side from Tottenham Court Road to Gower Street. Among recent applicants for current was the London and North Western Railway Company, for additional lamps for Euston Station.

Wallasey.—The other day Mr. Rienzi Walton held a Local Government Board inquiry regarding the application of the District Council for power to borrow £16,500 for electric lighting purposes. Applications for current have already been received sufficient to pay working expenses and interest.

West Ham.—Mr. Willcocks held a Local Government Board inquiry here last week respecting the Council's application for power to borrow various sums, including £50,000 for electric lighting.

Whitechapel.—The District Board, last week, decided to inform the Guildford Electric Supply Company that they had already obtained a provisional order of their own to light the district, and that they contemplated putting it into force.

Wrexham.—The Town Council has resolved, "That the compulsory area of supply of electric light be—High Street, Hope Street, Regent Street, Queen Street, Henblas Street, Charles Street, Town Hill and Chester Street, up to the Guildhall, also Bridge Street, and that the area proposed to be included in the powers of the order beyond the municipal boundary shall comprise the portions of Stanty and Broughton lying within the Parliamentary borough, and the townships of Bersham, Erddig, Abenbury and Acton, and that applications for the consent of the R. D. C. be renewed."

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Belfast.—The Electric Traction deputation has submitted its report to the City Council. The latter body had a general discussion on the subject on Monday last, and there was a good deal said against the overhead system, but eventually the report of the committee, favouring the scheme of the Tramway Company, was adopted.

Ceylon.—The following paragraph, taken from an Indian contemporary, is a bit of a conundrum:—"This tramway scheme has a fair chance of being inaugurated after all. The report of the special committee has been adopted, and, best of all, the council have agreed to engage Mr. Preece, C.B., F.R.S., engineer-in-chief, postal telegraphs, G.P.O., London, as their consulting engineer. This will give some weight to their arguments whenever they have to argue on technical points, and it will make the good people of Colombo easier in their minds, as it is a sort of guarantee that they will get fair play from those terrible experts 'on the other side.'"

Cheltenham to Winchcombe.—Application has been made to the Gloucestershire County Council by Mr. Nevins, of County Wexford, Ireland, for their concurrence in the construction of a light electric railway between Cheltenham and Winchcombe. The matter had been discussed by the Finance Committee, who, through Sir John Dorington, expressed the opinion that such a railway would prove of great advantage to the district through which it would pass. The matter stands referred to the Highways Committee.

Dublin.—The question of the control or purchase by the Corporation of the tramway system, has been brought forward here. It was suggested by Councillor Beattie that the local authority seek powers to control, purchase or lease the lines, and work them by horse or mechanical power.

Germany.—Messrs. Felix Singer & Co. (Electricitäts Gesellschaft) of Berlin, inform us that they have obtained in the introduction of the Walker electrical material a new and very important success, competing against the most prominent electric companies of Germany. The Upper Silesian steam railway, which passes through the whole industrial district of Upper Silesia, has determined to transform its traction with steam locomotives into such one with electric motors. The electric traction will be introduced at first on the lines: (1) Gleiwitz, Zabrze, Koenigshuette, Beuthen, Deutsch Piekar; and (2) Koenigshuette, Kattowitz, Laurahuette, Koenigshuette, for which 30 motor cars and a corresponding number of trailers are provided, also freight traffic will take place on the above-named lines. The cars are mounted on two swivel trucks of 785 mm. gauge. Each of the four axles will be driven by a street railway motor of 18 20-H.P. Messrs. Singer have secured the order for the electric installation of these cars, consisting of 120 motors and the whole electrical outfit, *i.e.*, the necessary controllers, safety devices, lighting apparatus, &c. The stipulated gauge is rather a small one for an electrical street railway car having motors mounted in the usual way. This narrow gauge was caused by local circumstances. Messrs. Singer, assisted by the Walker Company, whose representatives they are, have overcome these difficulties by devising a new special motor type for this gauge. The whole length of both lines is about 33 km.

London.—It is stated that the London United Tramways Company contemplates making another application for powers to substitute the electric trolley system for horse traction on its lines from Hammersmith to Kew and Richmond, and from Uxbridge Road Station to Acton.

Longton.—The agreement between the Longton Town Council and the British Electric Traction (Pioneer) Company, Limited, for the construction and working of light railways in the borough, and from Longton to Trentham and Blyth Bridge, has been approved by the Longton Council, and the common seal of the borough affixed thereto.

Motor Cars.—Motor cars were largely used at Coventry on Monday to convey voters to the poll in the Municipal election. The Warwickshire County Council restricts the speed of these vehicles to 10 miles an hour, but no such limit is imposed at Coventry.

South Staffordshire.—A Staffordshire paper learns from a reliable source that the whole of the existing tramways in South Staffordshire (the Walsall system excepted) are shortly to be amalgamated. Contracts are about to be signed whereby the various lines are to be acquired by a London syndicate, and, when so acquired, extensions will be made and the lines worked on a well-considered system. The syndicate proposes to take over the South Staffordshire line (which extends from Handsworth through Westbromwich to Wednesbury and Walsall), the Wolverhampton Borough Tramways, the Dudley and Wolverhampton, and the Dudley and Stourbridge lines. The company moving in the matter has no connection whatever with the syndicate which is taking over the Birmingham systems.

The Earl's Court Underground.—The *Daily Mail* for Saturday last stated that a meeting was held on Friday afternoon between the District Syndicate and the board of the Railway, in regard to the electric sub-district scheme. "Mr. Forbes was away ill, and the notice convening an extraordinary meeting of shareholders cannot, therefore, be sent out before Saturday. Only one director is opposed to the scheme. It is understood that pressure is being exerted to induce the syndicate to provide a station for the Imperial Institute and Albert Hall. We understand that Sir Benjamin Baker, in his report, suggests that the originally proposed capital of £1,000,000 is insufficient, and proposes that a little over £1,400,000, should be provided to include the expanses of sidings and a gradient from Gloucester Road to Earl's Court, so that trains may be run through without passengers having to change."

The Horseless Carriage Regulations.—The Local Government Board will shortly issue its regulations which are intended to supplement the provisions of the "Locomotives on Highways Act," which we have already published. Advance copies of these regulations have been forwarded to the County Councils of England and Wales, the Metropolitan Vestries, and all other highway authorities. In these regulations it is stipulated that as to the construction of motor cars if a car exceeds 3 cwt. in weight, it shall be capable of being so worked that it may travel either forward or backward, and, whatever its weight, it must not exceed 7½ feet in width, measured between its extreme projecting points. As to tyres, the Order says that if a car weighs between three-quarters and one ton the tyres must be not less than 2½ inches wide; if between one and two tons, 3 inches; and if between two and three tons, 4 inches. There must be no boxes or projections, except in the case of pneumatic tyres, when there may be boxes or projections of the same material as the tyres. Every car must be provided with two independent brakes, so powerful that if the car is travelling at the rate of 14 miles an hour it can be stopped within a distance of 50 feet. The name and address of the owner must be written upon the side of the car, which must be driven by a person competent to control it. Lamps must be carried at night, and the driver shall whenever necessary give sufficient warning of the approach of the car by sounding a bell or by other sufficient means. The driver must also, on the request of any police constable or of any person having charge of a restive horse, cause the car to stop and to remain stationary so long as may be reasonably necessary. With regard to the question of speed the Local Government Board, after reminding the local authorities that the limit in the Act is 14 miles an hour, states that it does not propose to make an order until the general regulations have come into operation.

The L.C.C. and Motor Cars.—The County Council on Tuesday approved of an opinion expressed by the Highways Committee that the speed of motor cars in London should not be allowed to exceed eight miles per hour.

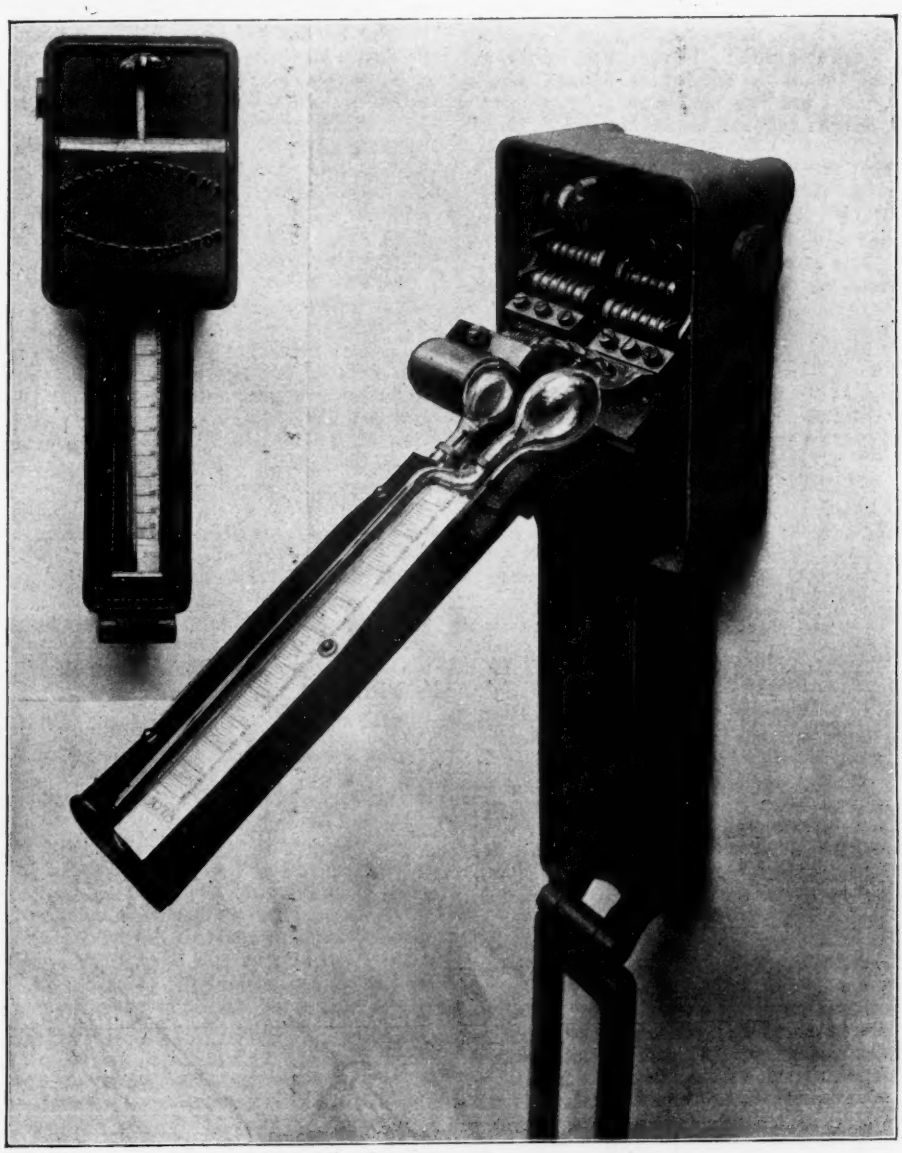
METHODS OF CHARGING FOR ELECTRICITY.

The Wright Rebate Indicator.

Our readers will be generally aware of the methods adopted by Mr. Arthur Wright at the Brighton Corporation Electricity Works for charging consumers of electricity upon a sliding scale, which offer several inducements to those who take their supply for many hours continuously. The principle upon which Mr. Wright has gone, of charging a constant profit rather than a uniform price, was first clearly enunciated by Dr. John Hopkinson, who has carried it into practice at Manchester. The principle remaining the same, the methods of Mr. Wright and of Dr. Hopkinson differ only in the way in which they have been applied, and that other engineers agree with the principle is shown by the interest taken in the subject, and the numerous ways, differing from one another in detail, in which local conditions and personal opinions have embodied it so as to suit the needs of towns and cities all over the kingdom.

We published some time ago some of the results that had been obtained at Brighton since the maximum demand indicator came into use. Like most other metering appliances, this instrument has been improved in construction, and altered in such parts as have been found to be susceptible to modification with advantage. We therefore propose briefly to describe and illustrate it as it is now manufactured, and then to say something as to the ways in which it is used in central station work.

The former pattern of demand indicator as designed by Mr. Wright, and made by the Reason Manufacturing Company, Limited, of Brighton, had three defects. The first of these was that the insulation was not all that could be desired, as vulcanised fibre was used to support the terminals, and this material is certainly hygroscopic. When indicators are left for months in a damp cellar, signs of surface leakage and electrolytic action have been noticed. In the later form vulcanised fibre has given place to ebonite, and the insulation has thereby been materially improved.



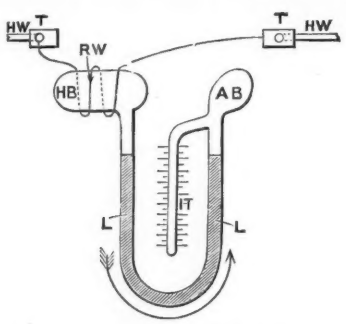
The Latest Pattern of Wright Maximum Demand Indicator.

Coming to the second point, those who have had the indicator in use are aware that it required to be cut out of circuit for a reading to be taken. It may be remembered that the instrument was to all intents a differential air thermometer on one bulb, of which a strip of platinoid or other resistance metal was wound, and the other bulb was sealed, but unprovided with any attachment. This latter was, however, bent over at such an angle, that on the liquid being driven up the tube to which it was attached when the registering fluid reached the top, it overflowed into this bulb, and was there

entrapped, being prevented from returning to its original home until intentionally allowed to do so on resetting by hand. When the current was flowing, therefore, the liquid occupied a position higher up in the indicating tube than it did when the coil and its bulb were cold. Thus the meter inspector was nonplussed, if, on his visit, he found a number of lamps burning, for it required a comparatively long time to allow all the parts to cool, and thereby obtain a true reading.

This thermal fly-wheel action was valuable in one way, as an accidental increase in current which lasted only a few minutes, and occasioned, say, by the consumer turning on all his lamps for a moment to test their effect, or other purpose, did not cause him to lose his much-prized rebate throughout the month, or other period over which readings were taken. While the sluggishness on the upgrade was a merit, it proved a demerit when operating on the downgrade, and we have known of consumers' bills which were made out against the supply company, simply because some lamps had been in use a few minutes prior to the visit of the company's official. In short, the instrument had to be cold were a reading desired, and it was therefore necessary for current to be cut off long enough to allow the cooling action to have full effect.

The third more important defect which proved troublesome, in reality does not appear to have been noted by those who have written about this ingenious little device. We read that "the instrument is reset by tilting the tube from the bottom, the scaleboard and tube being hinged to the upper part of the case. When tilted sufficiently, the liquid



T, Terminals.
H W, House wires.
R W, Resistance wire.
H B, Heated bulb.
A B, Air bulb.
I T, Indicating tube.
L, Liquid.
→ Direction of flow.

trapped runs down the tube and refils it, ready for use again." Unfortunately, when the tube was so filled, a bubble or bubbles of air went down into the tube with the liquid being carried over, so as to break the continuity of the liquid column. This occurred in most cases, despite every care in performing the operation, and as the meter inspector's day is limited, and his time has a distinct monetary value, this little bubble was a source of no little annoyance and vexation of spirit. To get over its freaks, the fictitious method of resetting had to be abandoned and the following substituted. The bulb which carries the resistance strip was warmed up slowly by a lighted match or taper being brought below it, and this was continued until the liquid had risen in the indicating tube and begun to find its way into the overflow bulb. The column and the mass of liquid previously trapped being now in contact, the bulb which had been heated was now cooled by blowing upon it, and the tube being inclined by tilting the carrier plate, the liquid returned gradually to the place from whence it originally came, without a break. Were the time that this little operation took to perform of no account it would not matter, but having to take all this trouble meant serious reduction in the personal efficiency of each meter inspector, and these gentlemen hardly relished their enforced detention in some of the places that may be good enough for electricity meters, but not altogether desirable for a human being.

Happily, we have to record a change from all this, the indicator illustrated being free from the rather undesirable features of its prototype. From the adjoining views, it will be noticed that, instead of an entrapping bulb, the right-hand tube is provided with a third limb, and the bulb remains merely as a cushion and air reservoir. This new appendage is the indicating tube and trap-well; as the liquid column rises in the right-hand limb it is shorn off, and runs over the tee-joint formed by the two tubes and down into the indicating tube. Here its height is a measure of the maximum current that has been passed through the instrument since it was last reset.

The indicator shown in our view will carry 60 amperes, and has a good scale from 10 amperes upwards; from 35 to 60 amperes the divisions being open and easily read. The scale to the right gives amperes. If desired, a scale of "Units to be consumed per half-year before the reduced price is charged" is set out on the left of the centre tube. If the rebate be given per quarter, the scale is adapted to this, or to any other system that may be in vogue. In the former type of instrument the indications were from the top downwards, being due to the abstraction of fluid by that which was trapped. Now, the scale begins at the bottom, and reads upwards. It is obvious that the readings are unaffected by the instrument being in circuit with current flowing. All that is necessary is, that the maximum current to be recorded shall have been on for at least 15 minutes before the reading is taken. Whether this be so or not, can be ascertained by noting any signs of liquid still flowing into the indicating tube. If these be present, then taking off the reading must be delayed until they cease.

To reset, all that is necessary is to slowly tilt out the tube to the position shown, and a little above it, when the liquid flows over, and back into the U-tube, without any trouble. Among minor improvements may be noted the ligamentary hinge connections from the movable to the fixed portions of the electric circuit; heavier and more substantial terminals; the scale-card carried by short distance pillars, so as to lie flat; the more convenient shape and reduced width of the case; the substantial handle at the lower end of the scale-board (in place of a flimsy brass eye screwed therein); covering up necessary but unsightly parts of the U-tube and holes in the catch at the top of the case, so that a wire or string may be slipped through, and the indicator sealed against unauthorised interference.

These instruments have always been businesslike, in that they are fitted with cast-iron cases, having a glazed inspection window. They can be secured to a back-board or to plugged holes in a wall by large screws put through from inside. The cables come in through bushed holes in the case, and go straight into proper terminals, so that no bending or twisting is necessary. The demand indicator is usually fixed next the watt-hour meter or ampere-hour meter, and is inserted in the same wire or cable.

The Uses of the Demand Indicator.

The prime use of the "demand indicator" or "rebate finder," is to show the maximum current that has been taken from the street mains since the date at which the meter was read and the indicator reset. As electric supply is given under the Board of Trade rules, and these require a "declared pressure" to be made known to the consumer, and maintained within 4 per cent. of its value at all times (a regulation which we very much fear is not *always* acted up to by low tension companies, and occasionally broken even by high tension men), the units per hour can be calculated by a simple arithmetical rule, and from this, by the assistance of the integrating watt-hour meter or ampere-hour meter, the average number of hours per day the supply has been taken can be found. Thus:—

$$\left.\begin{array}{l}\text{Average number of hours per day the "maximum demanded supply" has been used during the quarter.}\end{array}\right\} = \frac{\text{Units used during quarter.}}{91 \times \frac{\text{Reading of demand indicator} \times \text{declared pressure.}}{1{,}000}}$$

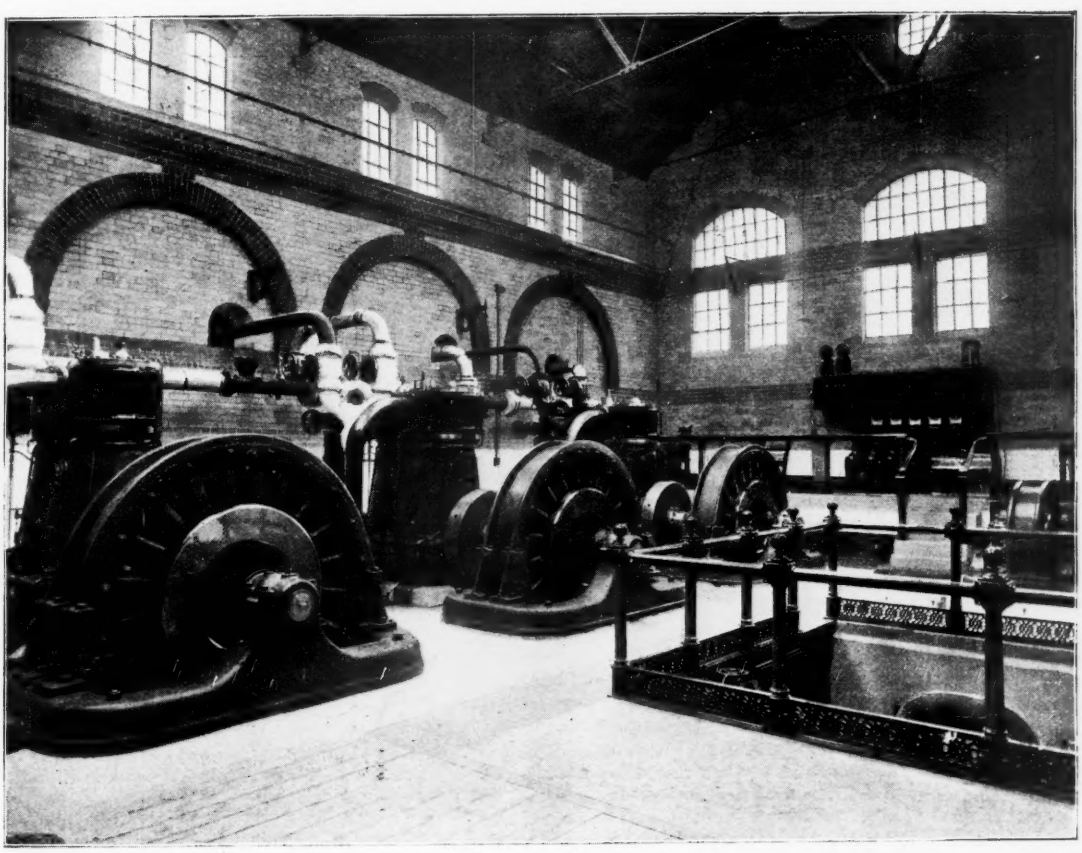
If the supply be measured by an ampere-hour meter, this method of arriving at the average hours per day is strictly correct; but if a watt-hour meter happens to be installed, then the average hours-per-day calculation gives a result in the favour of the consumer to a slight extent; but as the consumer does not directly benefit by an increased pressure, except in so far as his lamps give a better light than they would otherwise do, this is a fair arrangement. The increased brilliancy of a fixed number of lamps tends to make users satisfied with the supply, while it does not materially add to the plant expenditure of a station (which is fixed by the ampere load), but is made up by a slightly increased coal bill.

In everyday work the calculation is effected by a table of discounts, which co-relates the current representing the "maximum demand," as shown by the indicator, and the number of units that have to be taken per quarter, per half-year, or per annum, before the price is reduced, and a rebate allowed.

In fine, the demand indicator affords a ready means of determining the proportion of plant that has to be kept in readiness at the works of a supply company, and the intervening mains and other apparatus that is required to supply a consumer. The supply is measured by the integrating meter, whose indications represent the use made of his proportion of plant by the consumer. The smaller the demand, and the greater the units sold, the lower is the price per unit at which electricity energy can be furnished to any consumer. All classes of consumers are charged at a constant profit rate, inasmuch as the less it costs to give any individual a supply, the smaller is the charge made on him. Herein the sliding scale, based upon a measured maximum demand, has an advantage over other methods of assessing his value as a revenue-yielding unit. From the point of view taken by Jerome K. Jerome in his "Idle Thoughts of an Idle Fellow," the consumer exists only in the estimation of the supply company for the purpose of paying his quarterly bill, and enabling them to dispose of a certain number of units per annum. Judged from this standpoint, one can appreciate why large and fashionable shops addicted to early closing are not regarded by the station engineer of the importance, and given the deference which the proprietors and managers of such premises seem to think should be accorded to them.

A good deal of discussion has taken place recently with regard to the advantages and disadvantages of different methods of charging for electricity. It may be said without much fear of contradiction that no one method is applicable to all cases. A particular method may be right, proper, and fair for lighting, but it does not necessarily follow that it is so for other kinds of demand. If a motor load could be encouraged until it became of real importance, and by some restrictions it at the same time could be prevented from clashing with the lighting load or overlapping on the load curve, the daylight supply could be given at a figure which cannot be touched with ordinary station load factors. Some years ago we illustrated and described the switch which Mr. J. T. Baron designed to deal with this case, and those who know the construction of this device will be aware that it requires two meters, one of which is used to meter the daylight supply only (this being charged at about half the ruling price), and the other is in circuit with all the apparatus which may require to be in action after dusk.

For a lighting load solely, or a lighting load in conjunction with others of relatively less importance, the demand indicator affords a satisfactory method. Mr. Gibbings has dealt with some of the methods of charging adopted in different towns in these columns some time ago, and his observations apply with as much force to-day as when they were written. Since their appearance the demand indicator has come into extended use, and the results have proved satisfactory in all respects except one, and that is the difficulty of convincing the non-technical consumer that a benefit is conferred on him by the principle of charging directly as the demand, and inversely as the consumption. How difficult it is to explain tersely and intelligently to the small shopkeeper the incidence of his demand on the price he will have to pay per unit can only fully be understood by those who have had to essay the task and meet all objectors with business courtesy. We know that those who reap the reward of long hours understand that they are better off than their neighbours, but the latter don't quite see why the other—who is often in their opinion a much more humble individual—should be so much prized by the suppliers of electricity.



Interior View of Generating Station.—Croydon.

For some reason that is not quite so clear as other things in connection with the demand indicator, it is held by some that the rebate cannot be given on each quarter's bill, but must be deducted at the end of the year. As a matter of fact, it seems to be equally rational to deal with the supply for one quarter as to hold back the rebate until two or more quarters have been paid; if the method is right in the one case it must be so in the other.

The Brighton scale is readily understood by those who take the trouble to glance at their meter cards, and at the left-hand scale on the demand indicator. The full price is 7d. per unit, and this has remained unaltered, as it represents the daily proportion of standing charges, which are incurred by the necessity of being ready to supply. When one hour's consumption per day has been taken, these are partially wiped off, and the further quantity, whatever it may be, is given at a remarkably low figure—2d. per unit. Thus, whatever the demand indicator shows to have been the maximum hourly consumption becomes the basis, and when 91 hours per quarter have been passed, the additional quantity can be sold at but little over the running costs incurred in providing coal, oil, water, and engine room stores.

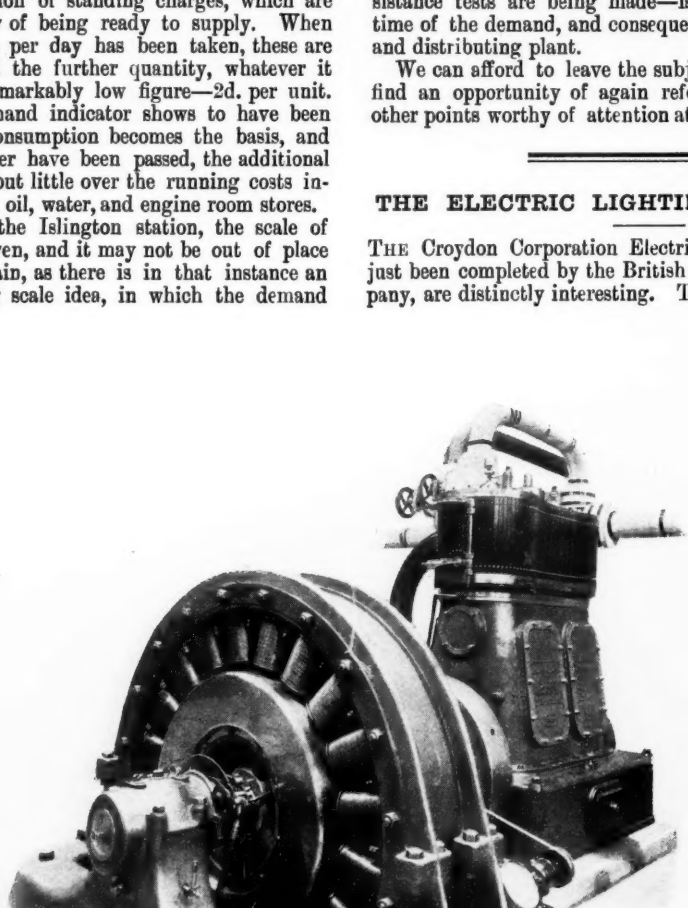
When we described the Islington station, the scale of charges in vogue was given, and it may not be out of place to retrace the ground again, as there is in that instance an elaboration of the sliding scale idea, in which the demand indicator plays an important part. The first two hours per day of the maximum demand are charged at the full price of 7d. per unit. Should this be exceeded, then the third hour is given at 6d. per unit, but if there be more than three hours, and less than four, the third and fourth hour's consumption are charged at 5d. per unit. In the event of the consumption being still greater than this, then all over the first two hours is sold at 4d. per unit. In addition to the sliding scale which is applied to all ordinary cases, there is a special inducement offered to purely daylight-hour consumers, who may have all they want at 3½d. per unit. There is, of course, something to be said against the introduction of more than two prices on the sliding scale; but, on the other hand, by doing so a rebate can be offered to the very best class of customers — those who light up early and shut up shop in the early hours of the morning—such as would not otherwise be possible in the first few years of a new station's operation.

The demand indicator certainly performs a good service in enabling the real value of a consumer's demand being ascertained in lieu of his being classed as having a demand coincident with the number and size of lamps that he happens to have thought fit to put up in his premises. The wiring contractor is only too frequently the cause of overburdening the tradesman in this way, for the latter often has little idea of the effect to be obtained from a reasonable number of lamps judiciously disposed over his wares, and finds out when current is turned on that, although his place is beautifully illuminated, the price at which this is reached is more than he bargained for. Prudence counsels him to bring down his lamps to such as meet his reasonable requirements, and he is more likely to listen to her soft voice than to neglect it. "Lamps fixed" can in no way be taken as a measure of demand in shops, houses, and offices, as the conditions of one class differ greatly from those of another; and even were this not so, it is not a matter of importance to the people at the station, whose sole concern—except when insulation resistance tests are being made—is with the magnitude and time of the demand, and consequent load on the generating and distributing plant.

We can afford to leave the subject at this stage, and may find an opportunity of again referring to these and some other points worthy of attention at a convenient future time.

THE ELECTRIC LIGHTING OF CROYDON.

The Croydon Corporation Electricity Works, which have just been completed by the British Thomson-Houston Company, are distinctly interesting. They are not extensive, and the plant is not specially remarkable for size, but there are novelties in the details of the system that are worth noting.



Combined Alternator and Engine, Croydon.

The Croydon Corporation, when it decided to adopt electric lighting, did so in a spirit of compromise. It would not suffer a company to commence operations in the borough, and yet it scarcely liked to bear the burden of a concern that might produce no dividend for the first two or three years. So the end of it was that the Electric Lighting Sub-Committee invited 12 companies and firms of electrical contractors to make offers to the Corporation upon the basis previously adopted by the Council. Six firms sent in tenders, and Prof. Kennedy, whose opinion the Council sought, selected that of the British Thomson-Houston Company, Limited. Their contract price was £15,986, but they considered that the sum of £21,000 would be required to provide a complete system for the compulsory area, including the necessary professional expenses. The company expressed their willingness to work the undertaking for five years, and guaranteed to pay to the Corporation 3 per cent. interest on the capital laid out, and such sinking fund as the Corporation might have to provide, not exceeding 3 per cent. on the amount. At the end of five years the contractors would have no further interest in the matter, and the plant would remain the property of the Corporation. The Committee thought, however, that in view

of future possible extensions of the system, it might be desirable to construct larger buildings, &c., than would be necessary for the compulsory area alone, and they therefore considered that an application should be made to the Local Government Board for permission to borrow £27,500 for electric lighting purposes.

After this there was the inevitable Local Government Board inquiry and the inevitable delay. In December of last year sanction was given to the Croydon Corporation to obtain a loan of £27,500 for the purposes of electric lighting, to be repaid in 25 years. Eventually a scheme was adopted which embraced the following:—Three multitubular boilers, two feed pumps, a fuel economiser, three compound vertical condensing engines, each driving a 120 kw. alternator; and one or two dynamos with accumulators for the day load. There were to be three or four high pressure feeders running to five transformer sub-stations in the centre of the town, the power sent being 240 kw. at 2,000 volts. Consumers in the compulsory area were to be fed from the low pressure mains, isolated consumers being connected with the high pressure feeders through separate transformers. The mains were to be concentric throughout, and the earthing of the outer conductor was contemplated, with the permission of the Board of Trade. The initial capacity of the station was to be 10,000 lamps. The compulsory area, which is something like half a square mile in extent, consists almost entirely of shops and business premises.

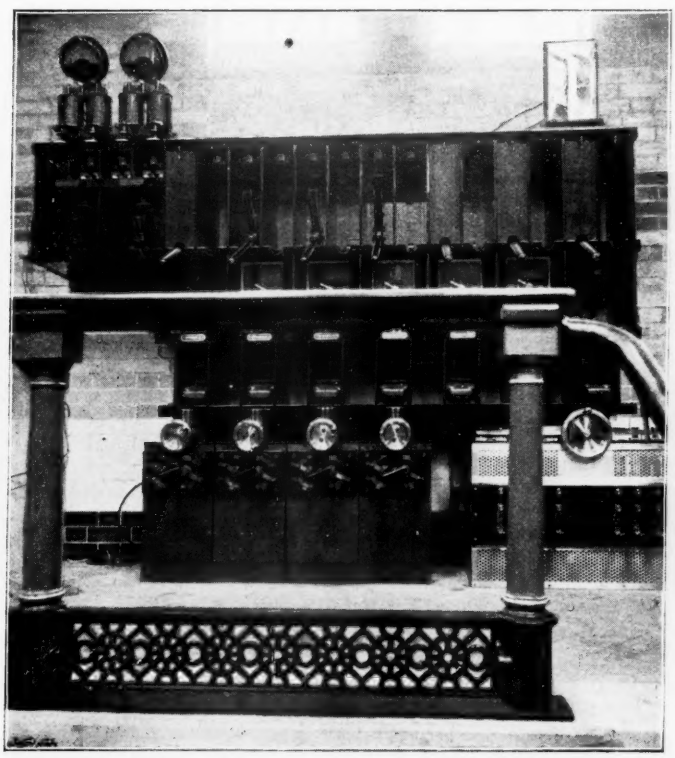
This scheme has not been carried out in its entirety, but it will be seen in the course of the following remarks how far it has been departed from.

The works have been now practically completed on a site some distance from the centre of the town, and near to the gas works, which, by the way, are owned by a company who charge 2s. 8d. per 1,000 cubic feet.

The generating station is a neat red brick building, which contains boiler house, dynamo room, accumulator room, and various offices. The plant erected at the present moment consists of three Davey Paxman economic boilers, which will raise steam equivalent to 300 H.P., when working at a pressure of 160 lbs. Hopkinson fittings are used throughout. There is a double feed to the boilers, hot and cold, the water being taken through a Kennedy meter, which gives direct readings. Two Worthington pumps and a set of Green economisers are erected. A notable point about the feed pipes is that the ring main system is departed from, though duplicate mains are employed, an engine house main and a boiler house main, which gives a double supply on to the engines. The whole of the feed pipes are of copper, with steel flanges on them. Magnesia coverings are used for the pipes, and from our own experience is very effective. At the present moment, the exhaust is to the atmosphere though a special condensing apparatus, has been laid down and completed by Messrs. Browett & Lindley.

The interior of the generating room presents a most pleasing appearance, and the excellent arrangement of the plant may be judged from our illustrations. One side of the room is occupied by the three sets of steam generators, while the other half of the floor is mainly taken up by a well, in which the condensing apparatus is placed; beyond this is the motor alternator, of which we shall have more to say. Between the condenser well and the motor generator is a space which is destined for the Ferranti rectifiers, which will be shortly erected. One end of the room is occupied by a platform, on which the switching gear has been erected. The extensions of the plant will take place from the other end of the room, where a wooden partition does duty as an end wall.

The main generating plant consists of three 120 kw. alternators direct coupled to Belliss double-acting engines of the closed-in type. The alternators are the well-known Thomson-Houston manufacture, and were specially designed by Mr. H. F. Parshall. They run exceedingly smooth, and show little tendency to become hot. They run at a speed of 300 revolutions per minute, and generate current at a voltage of 2,000 to 2,200. The bearings of the alternators are self-lubricating, which is effected by means of a special ring placed on the end of the bearing which carries the oil round in a continuous stream. The connections are taken from each alternator to a Thomson recording wattmeter, and everything generated is measured there, and the direct output of the machines compared with the readings at the consumers' terminals.



Main Switchboard.—Croydon.

The engines and alternator are placed independently of each other on the concrete foundation, on the stability of which they depend for the correct alignment of the shafts.

The engines are of the two-crank compound self-lubricating type, Belliss's standard E.C. 10 size, the cylinders being 12 and 20 × 9½ inches stroke. The engines are designed to develop 240 I.H.P. when running at a speed of 360 revolutions, with steam pressure at the engine steam stop valve not exceeding 150 lbs. per square inch with the vacuum equivalent to 25 inches of mercury.

The engines were tested before delivery to the full load on a water brake under the specification conditions, the trial being supervised by Prof. Kennedy or his representative. The water discharged from the condenser was weighed, with a result that at full load the consumption was found to be 17·9 lbs. per B.H.P., a result well within the guarantee. The engines were also run for a period of six hours continuously, at the full power, to the inspecting engineer's satisfaction.

The alternators have 20 poles, and run at 360 revolutions per minute. Prof. Kennedy specified that the arrangement and winding of coils and field were to be such that the E.M.F. can be varied between 2,000 volts on open circuit, and 2,200 volts at full output on a non-inductive circuit, the speed of the engines being kept constant.

The windings of the armature were to be such that the machine will stand double the normal full load current for five minutes continuously, if the terminals of the machine be

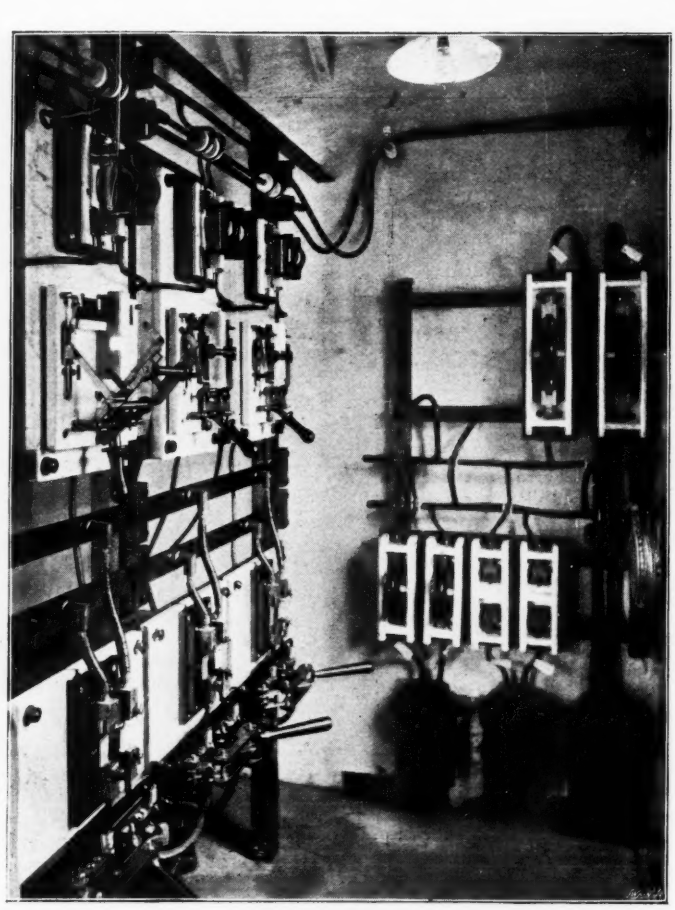
short-circuited and fully excited, without causing any damage by heating or otherwise.

The insulation of the armature was to be such as to be capable of resisting the application of an E.M.F. of 4,000 volts alternating continuously, without being pierced, and the temperature of no part of the armature or field to exceed 70° F. above that of the surrounding air, after a continuous run of six hours at the maximum specified load of 120 kw.

The armature consists of finely laminated iron fixed to a cast-iron spider firmly keyed to the shaft. The windings are laid in slots at the periphery of the armature, and are secured in place by wooden wedges, thus providing against any possible movement of the conductors in the slots. The coils are wound on forms and slipped in place, thus providing for use in manipulation and repair.

The field magnet system consists wholly of laminated sheet-iron held between steel flanges, and so arranged that there is a clear passage for air from the inside to the outside through the laminations, and also through the inside of the field magnet spools. The field is divided diametrically, to give easy access for repairs to the armature by removal of the upper half of the field.

One of the most interesting features of the station, however, is a motor alternator, which fulfils as many functions as a general utility man in a travelling dramatic company. One end is driven from the generators as a synchronous motor, thus driving the other end of the machine as a continuous current dynamo. The current thus generated is utilised for charging a set of batteries, and the stored energy thus obtained is employed for exciting the field magnets of the alternators; moreover, at the time of light load, and on Sundays, the battery is used for driving the continuous current machine as a motor; thus a high pressure alternating current is obtained from the combined machine, which is sufficient to meet all the requirements at the time of minimum demand.



View of a Sub-Station.—Croydon

The sole object of the battery is to drive the small machine and to excite the fields of the alternators, and, in case of emergency, it would be possible to have the curious arrangement of depending on the batteries for some time to keep up a supply of alternating currents to the extent of 30 kw. The battery room adjoins the engine room, and here two batteries of 60 cells each have been erected. An interesting feature is the use of an infant booster, which when run from the battery furnishes a current on the other commutator at a voltage varying from 2 to 10 volts. This arrangement dispenses with hospital cells, and instead of cutting out a faulty cell, it is simply connected to the low voltage side of the booster, and brought up to a proper working condition. This small motor dynamo also fills a useful purpose in the testing of meters. The cells are of the E.P.S. type, and their condition is indicated by an Aron meter with the Miller modification; they are charged at 160 volts, and discharged at 120. The batteries are regulated and controlled from a small low tension board made by Messrs. J. H. Holmes & Co.

The main switchboard has been made by Messrs. Ferranti, Limited, and is of their well known type. Compound resistances are furnished for each alternator, and a special resistance frame is provided, which will regulate the fields of the alternators at the same time. The idea is to have two bus bars from which the fields can be regulated, thus giving two different voltages. It is the intention to work the machines in parallel, the paralleling being done through a small fuse, and after synchronism has been attained, the main switch is closed; a voltmeter instead of a lamp is used for synchronising. Kelvin instruments are used on the switchboard, and the fuses, which are of Ferranti's special type, are in duplicate.

The mains from the switchboard are taken to the various transforming stations, there being four at the present moment. The arrangement of the main generating station and the transforming centres are roughly shown in the diagram. It will be seen that the system of interconnection is very thoroughly carried out, the feeders connecting each sub-station together, and the distributing mains can be also connected together by junction boxes placed at different points. An illustration shows clearly the arrangement of a transforming station; in the centre of the room is an iron frame on which the feeder and distributing switches are placed. At right angles with this frame are the interconnecting switches for feeders and distributing mains. The switches, as well as the transformers, are of the British Thomson-Houston type.

The mains, it may be mentioned, are laid direct in the ground, and possess some special features. It is interesting to note that the Corporation of Croydon are impressed with the value of electricity for street lighting, and at the present moment about 50 arc lamps have been erected, mainly in the centre of the town. They will be fed direct from the station by rectified currents, the lamps being arranged in two circuits.

The whole of the contract for the underground mains has been carried out by Callender's Cable and Construction Company, Limited, of 90, Cannon Street, London, E.C., who have both supplied and laid the cables, and have carried out all the excavation of the necessary trenches with temporary reinstatement, the permanent reinstatement of the streets being carried out by the Croydon Corporation.

As we have already pointed out, current is supplied to the feeders at a pressure of 2,000 volts, and then transformed down at the various sub-stations to a distributing pressure of 200 volts.

From the generating station three main feeders are run; one ·09 square inch concentric to sub-station A, in Market

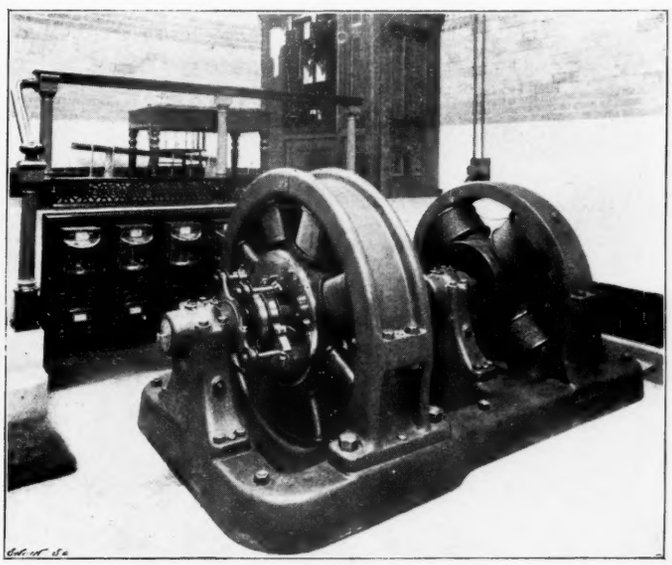
Street, a distance of 1,200 yards. A second ·08 square inch concentric to sub-station D, in Station Road, a distance of 1,100 yards; and a third ·07 square inch concentric to sub-station B, in Mint Walk, a distance of 1,550 yards. A branch feeder, ·04 square inch, is run from sub-station A to sub-station C, in Wellesley Road, 360 yards in length.

In addition to these feeders, the sub-stations are interconnected by means of a ring main, ·025 square inch.

In the sub-stations, the concentric cables are led into dividing boxes bolted on to the wall, and from these dividing boxes two single conductor cables of vulcanised bitumen are led to the station 'bus bars. The dividing boxes are filled up with compound specially prepared by the Callender Company, so as to effectually seal the cable ends.

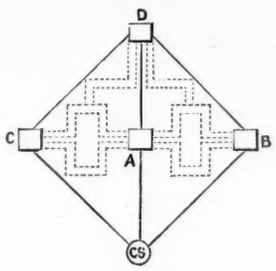
The feeder cables are Callender's well-known concentric type; each of the conductors is insulated with a dielectric of bitumenised fibre, and the outer dielectric encased in a solid lead tube, the lead being put on under great hydraulic pressure. The cable is then served with yarn thoroughly compounded, and finally protected by an armouring of two steel tapes or ribbons of carefully selected mild steel; the cable is then served with an outer covering of jute yarn, and finished off with hard compound.

These cables are laid direct in the ground, and about 3 inches over them are placed tarred boards 6 inches × $\frac{3}{4}$ inch, so as to give an indication to anyone opening the streets at a future date of the presence of the mains.



Motor Alternator at Croydon.

From each of the sub-stations a network of low pressure concentric cables, similar in type to, but less heavily insulated than the feeders, is carried through the principal streets of the town, and distribution is made on the two-wire system at 200 volts.



Feeders shown by solid lines and distributors by dotted lines. C S, Central Station; A B C D, Transforming Sub-Stations.

Plan of Feeders and Distributing Network.

The section of the low tension cable is ·10 square inch, with the exception of two short lengths of ·25 square inch leading from sub-station A to the junction of North End and High Street. In ordinary working, the different sections of the network leading from the various sub-stations will not be connected together, each sub-station distributing current to its own separate section of the network.

Network boxes, however, are provided at various points marked ▭ on the plan, at the present moment eight in number, so that when desired the separate sections can be connected together. About 6,000 yards of distributing main has at present been laid.

The network boxes are placed in brick pits, 24 inches × 24 inches inside measurement, set in cement, and provided with cast-iron frames and surface covers. The network boxes themselves are placed on brick piers inside the pit, the piers being 1 foot high; the brick pit is drained by a 2-inch pipe.

The service cable used is of a similar type to the distributors, the sections being ·022 square inch and ·064 square inch in area. This runs from the mains direct to the consumer's premises, where it terminates in one of Reid's patent cut-out boxes. This box acts not only as a cut-out, but as a permanent seal for the cable end preventing any injury to the cable, even in damp cellars.

In addition to the supply for private lighting, cables for two arc lighting circuits for public lighting have been run from the generating station through the busy thoroughfares of the town.

These cables are manufactured precisely the same as those for the feeders, and are laid direct in the ground, then covered with tarred boards, similar to the feeders. In all 7,500 yards of arc cables have been laid.

The arc lamp services consist of a twin cable of vulcanised bitumen, lead sheathed and armoured, tapped off the outer conductor of the concentric main by means of a special branch box, designed by Callenders, and leading to the switch terminals in the base of the lamp-post.

At present there are 40 lamps on the two circuits, and it is intended that one circuit shall be run all night, and that the other shall be shut down at midnight.

The positions of the arc lamp-post are shown on the accompanying plan, a distinction being made between the all night and half night circuits.

Altogether the Croydon Corporation can congratulate themselves upon a most interesting system of electricity. It is proposed to charge 6d. per unit, and at this price there should be no difficulty in securing ample patronage.

We are indebted to the contractors, the British Thomson-Houston Company, and especially to their resident engineer, Mr. Fell, for assistance in compiling this article.

EXPERT TESTIMONY.

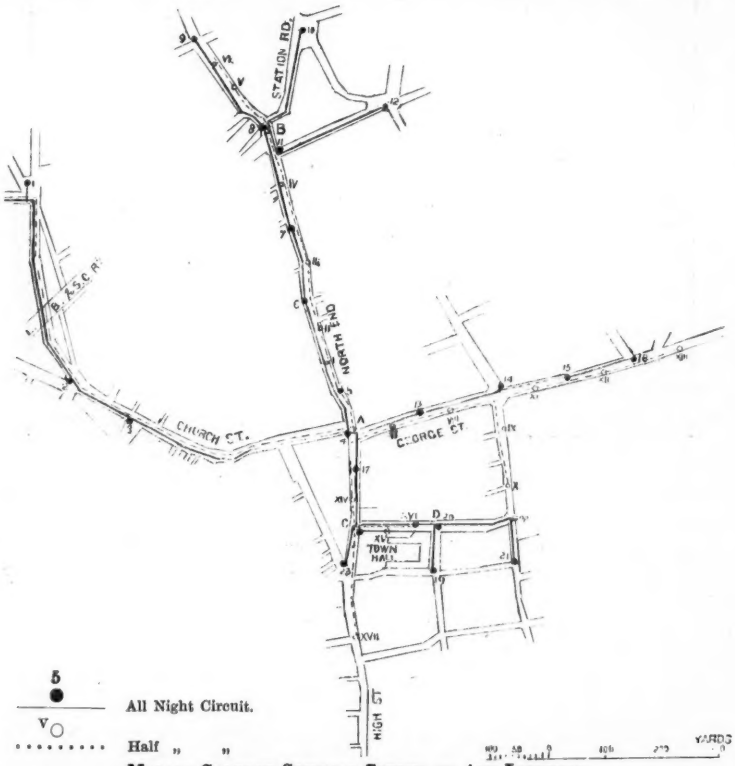
Within comparatively recent years there has arisen in our judicial system an apparent need for evidence bearing upon scientific questions requiring a knowledge not ordinarily possessed by the lay witness, and which is gradually being more and more supplied by the so-called "expert." He is paid to testify on behalf of one side or the other and not infrequently is retained to appear as often as cases arise in which his opinions are desired. That the most flagrant abuses in expert testimony have made themselves most prominent in criminal cases is perhaps to be attributed merely to the notoriety which these cases have attained. Whether it be the fault of our patent system or of our judicial system, the expert, says the *Electrical World*, has become a prominent

factor in all recent cases pertaining to patent litigation. It is not uncommon to find several experts on one side arrayed against perhaps as many more on the other, and if each side has been able to retain men of practically equal prominence, that side having the greater number frequently produces no little effect on influencing the judicial decision. That men devoted to the interest of science should be willing to sell their opinions indiscriminately to either contending party, often being obliged to so modify their views as to make them harmonise with the unscientific but legal opinions of the counsel by whom they are employed, has become an evil which has justly brought forth criticism, must be acknowledged, and unless modified or changed in some form, calls for future condemnation also.

In a contribution to the October number of the *Atlantic Monthly*, Prof. John Trowbridge calls attention to the imperiled dignity of science and the law if the practice of indiscriminate scientific testifying is to continue. He points out the difficulty in which a judge is placed when required to carefully weigh statements on scientific points; his attitude toward the scientific expert and the little regard he frequently holds for his opinions. He is therefore tempted to entirely ignore expert testimony and rely upon his own common sense for framing his decision. The consequence has been that judges may be classified under several headings, a classification based simply upon their legal decisions in the past, some being known as patent breakers and others the most strenuous advocates of broad patent claims. It is for this reason that suits are carried from court to court with the ultimate hope that a former decision will be reversed.

The result of this method has been well illustrated and can be vouched for by several of the larger manufacturing companies who have invested millions in this way during the past few years, with no immediate prospects of any material return on the investment. The chief benefit has been derived by patent lawyers and patent experts, while the stockholder has been forced to respond with the shekels. Prof. Trowbridge does not, however, raise his criticisms without suggesting a remedy. It is to the effect that a judge may call to his assistance any well known professor of science not retained by the parties in dispute. The state should provide and the judge should appeal to the state for such assistance so that he might be aided in rendering a decision based upon scientific facts.

By this method both the standing of the bench and that of the professor would "gain in dignity and the pursuit of truth will again be considered one of the chief characteristics of a scientific life." Whether the method suggested by Prof. Trowbridge could be put in practice and would be effective even if adopted can only be determined by an actual trial. It is, however, well to call attention to these points, so that those who are tempted merely from a pecuniary standpoint to offer evidence on scientific questions, when such evidence would not be in entire accord with their best belief, may stop to consider the effective gain to be derived by so modifying their convictions as to make them harmonise with those of the contending counsel. It is not improbable that the day of the expert will soon be waning and that the costly litigations of the past will not be duplicated in the future.—The *Electrical World*.



Map of Croydon Showing System of Arc Lighting.

ALTERNATING FROM DIRECT CURRENTS.*

In this paper entitled "A New System of Administering the Electric Current Therapeutically," Lieut. F. Jarvis Patten described a method for applying the electric current by producing an alternating current from a direct current by means of electrodes revolving in a receptacle containing acidulated water. Lieut. Patten stated that the method consisted in applying as nearly as possible a uniformly varying alternating current of absolutely unbroken continuity at a frequency of about one or two per second. He stated that he believed these to be essential features in the therapeutic application of alternating currents, the voltage following that of the true sine curve such as shown in fig. 1. A voltage of this kind could be produced by a specially constructed dynamo, but it would be a difficult matter to get a low frequency condenser, as the lowest machine speeds would be too high.

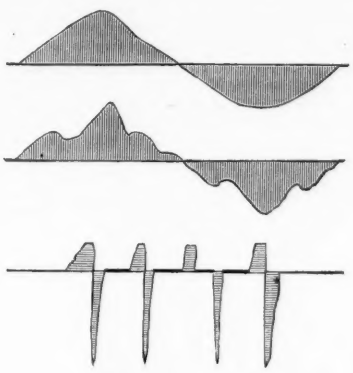
He stated that alternating currents for commercial machines often produced sudden and irregular changes of voltage, due to the presence of iron and rapid reversals. The irregular curve in fig. 2 shows in a general way the current delivered by ordinary induction apparatus, and supplied with an interrupted current from a battery or other direct-current source. The changes in the voltage are sudden and irregular, and the breaks are of comparatively long duration. Fig. 3 represents approximately the voltage curve of a commercial alternator with iron armature, the fluctuations of voltage of which are not so irregular, but the frequency is very high.

An alternating current of uniformly varying voltage, free from sudden interruptions and of very low frequency, can be produced by properly designing the apparatus shown in fig. 4. A circular vessel or tub containing acidulated water, is made of insulating material and provided with two carbon or platinum electrodes, C_1, C_2, which are connected to direct-current street-lighting mains, or to a battery as indicated. A vertical spindle in the centre of the vessel supports the horizontal arms, also of insulating material, and carrying at their extremities revolving carbon or platinum electrodes, C_3, C_4, which latter are connected to the insulating ring con-

* Abstract of paper read before the National Society of Electro-therapeutists.

tacts, R_1, R_2, fixed on a spindle and upon which bear the contact brushes, H_1, H_2, from which the transformed current is taken to the operating circuits connected with the terminals, A_2, B_2. The current from a battery or house circuit being turned on, the movable electrodes are revolved slowly by an electric motor or clockwork, and a uniformly varying and unbroken alternating current of as low frequency as may be desired is delivered to the operating circuit, A_2, B_2, from which any desired form of electrode, or other means may be used to supply the current to the subject.

Among others there is indicated a pair of tubs or pails for immersing the hands or feet, thus giving a current to the upper and lower extremities of the body. The apparatus is



Figs. 1, 2, and 3.

very simple and cheap, cannot get out of order with ordinary use, and transforms an ordinary street-lighting current of 220 volts, or that of an ordinary battery, to a uniformly varying current of any desired voltage and frequency. If the battery is used the voltage will probably be too low, in which case the transformed battery current should be passed through an ordinary step-up transformer, which can be con-

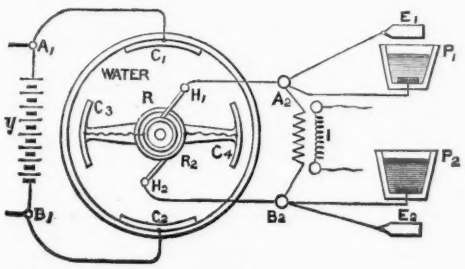


Fig. 4.

nected to give any desired voltage. Thus, with a dozen cells of storage battery and an ordinary 110-volt direct-current lighting circuit at his command, a physician with this apparatus can have what has some promise of being the best form of alternating current for medical use.

If the revolving plates or electrodes are made adjustable in position to and from the centre on the revolving arm, then by moving them toward the centre a liquid resistance is thrown in the operating circuit, thereby reducing the voltage of the street circuit by any desired amount. By thus connecting the revolving mechanism the water can be used as a mere passive resistance, so that the ordinary house-lighting circuit can be reduced in voltage sufficient to heat cauterising instruments. The apparatus can be made in a compact form, about a foot or 15 inches in diameter for individual use, or larger if desired, to carry heavy currents for sub-division among many operating circuits.

Crystal Palace Old Students.—The Second Annual Dinner of the above Society was held on Wednesday, October 28th, at the Trocadero Restaurant, Mr. G. Maxwell Lawford, A.M.I.C.E., Vice-President of the Society of Engineers, in the chair.

TELEGRAPH AND TELEPHONE NOTES.

Communication with the West Indies.—Last week's *Colonies and India* says: "The British North American squadron cannot be in two places at once, and as there is no cable communication between Halifax, its headquarters, and the West Indies, except so far as Bermuda, it seems only natural that the squadron should be divided between the two places. But why is the question of the cable from Bermuda to the West Indies allowed to lag? It is a very small affair, and yet may be of the utmost importance to the Empire from a political standpoint. And certainly its non-existence tends to throw the West Indies into contact with the United States, notwithstanding all the endeavours that are being made to bring about closer commercial relations between the West Indies and Canada."

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	April 6th, 1895 ...	...
Puerto Plata-Martinique ...	Dec. 19th, 1895 ...	...
Monte Alegre-Santarem ...	May 5th, 1896 ...	...
Para-Maranham	Oct. 8th, 1896 ...	...
Landlines.		
Trans-Continental line beyond Mazol	March 12th, 1896 ...	...
Carthagena - Barranquilla (Columbia)	July 4th, 1896 ...	...

Was Jay Gould Specially Favoured?—Mr. Edgar Tripp, of Port of Spain, Trinidad, B.W.I., writes to the *Chamber of Commerce Journal* as follows:—"Under above heading, in your issue for August, you publish a letter from Mr. C. W. Earle, chairman of the West India and Panama Telegraph Company, in which the correctness of certain allegations made by me at the Chamber of Commerce Congress in regard to the use made by the late Mr. Jay Gould of that company's lines is called in question. In reply I have to repeat what I have already written to the Government of this colony on the subject, viz.:—My statement was based upon information from good authority that, on the occasion of Mr. Gould's visit to Trinidad, the clerk in charge of the W. I. and P. T. Co.'s station here received instructions to the following effect:—(1) That special consideration was to be shown to Mr. Gould; (2) that his messages were to take precedence over all others; (3) that they were to be dispatched free of charge. My further information was that Mr. Gould availed himself largely of these privileges—sometimes to the extent of two hours daily, during which time he was put in communication with his office in New York, and all connecting lines were cleared and placed under his control. Mr. Miller, the local superintendent, has informed a Trinidad paper that Mr. Gould sent his telegrams at 'a reduced rate,' also that he did not personally use the wire, but sent some one else to do so, which appears to me to be immaterial. Mr. Earle now acknowledges that the cables were sent 'free.' The significance of these admissions and excuses cannot be overlooked. I do not think that Mr. Earle will deny that his company is more or less controlled by contracts with foreign companies, and, if I mistake not, Mr. George Von Chauvin, one of his directors, described as 'Nominee of the International Ocean Telegraph Company,' is the representative in England of the Western Union Telegraph Company, to whose influence over our telegraph service I referred at the Congress. In any case, as at present advised, I must repeat that my statements at the Congress were practically correct."

CONTRACTS OPEN AND CLOSED.

OPEN.

Ayr.—November 25th. Tenders are invited for the supply and erection of the following plant, for the Electric Lighting Committee; two Lancashire boilers and fittings, mechanical stokers, extensions to economiser, two 200-kilowatt steam alternators and condenser, cables and culverts. The ground plans of plant and specification, with terms and conditions of tenders and contract, may be obtained at the offices of Mr. Robert Hammond, the consulting engineer to the corporation, Ormond House, Great Trinity Lane, London, E.C., on and after November 10th, on payment of a deposit of £2 2s. for each copy.

Denmark.—December 4th. Tenders are invited by the Municipal Authorities of Copenhagen for the supply and erection of the necessary boilers, engines, dynamos, mains, &c., required in connection with a projected central electric lighting station at Vesterbro. Tenders to be directed to the Fourth Division of the Magistracy, Copenhagen.

Dundee.—November 10th. The Gas Commissioners want tenders for supplies of cast-iron pipes for electrical purposes, india-rubber-covered cables, and electricity meters. Particulars from the city electrical engineer, Dudhope Crescent Road, Dundee.

France.—November 10th. The French Post and Telegraph Authorities in Paris are inviting tenders for the supply of five lots of Baudot telegraph apparatus. Tenders to be sent to the Sous Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris.

Glasgow.—November 9th. The Corporation wants tenders for the construction and erection of fans and motors for the new sanitary chambers, Cochrane Street.

Hartlepool.—The British Electric Traction Company, Limited, of 1 and 2, Great Winchester Street, London, E.C., on behalf of the Hartlepool Electric Tramways Company, Limited, invite tenders for the construction of the permanent ways. Particulars, &c., from Mr. J. Vincent Kitchener, secretary, London.

London, E.C.—Tenders are being invited for the reconstruction of the whole of their lines of tramways, for the North Staffordshire Tramways Company, Limited. Full particulars can be obtained of Mr. J. G. B. Elliot, secretary, 18, Eldon Street, London, E.C.

Londonderry.—December 1st. The Corporation wants tenders for the supply of carbons for one year, from January 1st, 1897. Particulars to be obtained from Mr. John Christie, city electrical engineer, Guildhall. See "Official Notices."

Maryborough (Ireland).—November 23rd. Tenders are invited for the supply and erection of an electric light installation at Maryborough District Lunatic Asylum. Tenders should be sent to the secretary, Board of Control, Customs House, Dublin. Specifications, &c., will be issued on application to the Office of the Board of Control of Lunatic Asylums, Customs House, Dublin, on deposit of £3 3s. Plans can be seen at the office of the electrical engineer, Mr. Walter Leake, 35, Dame Street, Dublin.

Roumania.—November 16th. The Municipal Authorities of Bucharest are inviting tenders for the supply and erection of two auxiliary steam engines at the hydro-electric central station at Grozaresti. Tenders to be sent to La Mairie, Bucharest, Roumania.

Shoreditch.—November 17th. The Vestry invites tenders for the supply of the best insulated wires and mains for the interior wiring of consumer's premises, insulated iron pipes, junction boxes, switches, &c., &c., for one year. For further particulars apply to Mr. C. H. Doughty, lighting engineer, Old Street, E.C., also see our "Official Notices."

Southampton.—November 13th. The corporation invites tenders from engineers resident within the county borough for supplying and fixing the electric wires and fittings at the municipal offices, Guildhall, and police offices, Southampton, according to specification, which, with the form of tender, may be obtained of Mr. J. H. Lee, A.I.E.E., electric supply station, Back-of-the Walls, Southampton.

South Shields.—November 23rd. The Corporation want tenders for the supply and erection of alternator, engine, transformers, rectifier and extension to switchboard. See our "Official Notices."

Spain.—November 17th. Tenders are being invited until November 17th, by the Municipal Authorities of Alcazar de San Juan (province of Ciudad Real) for the concession for the electric lighting of the town during a period of 30 years. Tenders to be directed to El Secretario del Ayuntamiento de Alcazar de San Juan (Ciudad Real).

West Ham.—November 24th. The Council invites tenders for four steam alternators, mains, transformers, arc lamps, crane, &c. Particulars from the Borough Electrical Engineer (Mr. John J. Steinitz), Town Hall, Stratford.

CLOSED.

Bedford.—The County Council has accepted the tender of Messrs. Kilpin & Billson (£29 10s.), for the installation of the electric light in the Shire Hall. The tender was selected from four others.

Belfast.—The tender of Messrs. W. T. Henley's Telegraph Works Company, Limited, for the supply of service cable, has been accepted.

Belgium.—The Belgian State Railway Authorities in Brussels lately invited tenders for the supply of 54,830 metres of arc lamp carbons. Seven firms submitted tenders—three Belgian, one Dutch, two French, and one Austrian. The result of the adjudication will shortly be made known

Belgium.—The Société Nationale des Chemins de Fer Vicinaux of Brussels, lately invited tenders for the conversion of the "Vicinal" steam railways in Charleroi district (about 23 kilometres) with electric overhead conductor tramways. Four tenders in all were received—one Belgian, one French, and two German—the lowest being that of the Société Electricité et Hydraulique of Charleroi, which quoted 1,144,790 francs.

Birkenhead.—The Town Council has decided to accept the tender of Messrs. J. Gordon Alison & Co. for the electrical installation of the central free library for the sum of £89.

INTERNATIONAL SUBMARINE TELEGRAPH MEMORIAL.

On the motion of the Marquis of Tweeddale, Viscount Peel presided at a meeting of the Executive Committee of the International Submarine Telegraph Memorial, held at Winchester House, Old Broad Street, London, on Friday last. The following were present:—The Right Hon. Lord Kelvin, D.C.L., F.R.S.; Sir Robert Herbert, G.C.B.; Sir John R. Robinson; Sir Eyre M. Shaw, K.C.B.; The Most Hon. the Marquis of Tweeddale; and Messrs. H. Alabaster (Electrical Review); W. Andrews; W. H. Baines; J. Wolfe-Barry, C.B., F.R.S.; F. A. Bevan; W. G. Bond (*The Electrician*); Charles Bright; G. von Chauvin; J. C. Lamb, C.B., C.M.G.; W. H. Maw (*Engineering*); John Newton; F. C. C. Nielsen; J. Pendred (*Engineer*); E. M. Underdown, Q.C.

The Hon. Secretary read letters which had been received containing suggestions as to names which, in the opinion of the writers, should be associated with the memorial.

Mr. C. Bright then said he wished to propose a resolution as to the title of the memorial. He thought, as originally suggested at the shareholders' meeting of the Eastern Telegraph Company, this should be a personal memorial to the late Sir John Pender, and suggested that it should be couched in these words:—"To commemorate the leading part he took in promoting and establishing the commercial development of submarine telegraphy, and its extension throughout the world, especially through the East and Far East." It seemed to the speaker that Lord Tweeddale, at the meeting of the Eastern Extension Company on the Wednesday previous, made a very suitable allusion to the fact that it was proposed to commemorate the great work Sir John Pender had done in the development of submarine telegraphy. Mr. Bright thought it perfectly natural that the memorial should be of an international character, inasmuch as the financial work in which Sir John was so leading a figure was of an international nature, for which, in fact, honours were bestowed upon the deceased knight by foreign Sovereigns. The part he took in Atlantic telegraphy was not quite of such a leading character. He joined with ten others in putting down £10,000 in connection with the second Atlantic cable. It was afterwards that he took the lead in the promotion of the various companies to the East, and it was for that reason the speaker had inserted in the resolution he wished to move, "especially in the extension of telegraphs to the East and Far East."

The President of the Institution of Civil Engineers (Mr. J. Wolfe-Barry, C.B., F.R.S.) wished to second the motion, so that the matter might be thoroughly discussed. He felt the difficulty pressing upon anyone endeavouring to select those who merited recognition in the great enterprise other than Sir John Pender, who stands out prominently as being the moving force in it. When one came to suggest additions, there were the names of many who had been connected with the subject, either professionally as electrical engineers and navigating officers, or those who had shown the way in the various paths, and therefore he (the speaker) thought he was not doing wrong in seconding the motion.

Sir John R. Robinson thought it might be possible to inaugurate a memorial with which no names would be associated. He understood the object was to commemorate submarine telegraphy, and it was a difficult matter to select names to be connected with it, and that could not be done without giving offence and hurting the feelings of many.

Mr. J. C. Lamb, C.B., C.M.G., would support the motion with entire satisfaction if the words "Especially in the East and Far East," were omitted. When dealing with the very great work which Sir John did for the public, it would be a pity to add words which seemed to discount the importance of it. The recognition of Sir John Pender's part in the enterprise ought to be very full and hearty, and without any reserve. Sir John Robinson had raised the question as to whether this should not be a general international memorial of submarine telegraphy, without any names, but it seemed to the speaker that there was at the present time an absence of occasion. There was obvious appropriateness in a memorial to Sir John, who had just left us, and whose services were fresh in our minds. Mr. Lamb, owing to his position, had on some occasions had to meet Sir John as an opponent; but he could say that it would be with the most hearty feelings, and with the greatest possible satisfaction, that he should join in a memorial to him. The speaker was deeply impressed with the services Sir John had rendered to his country in establishing and maintaining that position of pre-eminence in international submarine telegraphy which Great Britain certainly occupied. There might be questions whether we held our own in certain directions, but that certainly did not apply to ocean cables. Sir John had done—not only his shareholders, that was a matter of course—but the nation a service which could hardly be exaggerated. More than that, Mr. Lamb happened to know that on many occasions their late friend had rendered immense service to the Government when they were in difficulties with regard to cable communication. While protecting the interests of his shareholders, he had been able to come in, at the nick of time, and render services which could not be weighed. The speaker would have been delighted to fall in with any scheme which secured general acceptance, but could not shut his eyes to the differences of opinion which had been expressed. The jubilee of *effective* submarine telegraphy would be in 1901, when also an International Telegraph Conference will be held in London, and if it were desired by the people of this and other countries to have an International Jubilee Memorial, that would be a suitable occasion, when representatives from every civilised country would be present.

Viscount Peel said the amendment was that the words "Especially to the East and far East be withdrawn," which was agreed to.

Mr. F. A. Bevan thought the committee should be quite clear as to the effect of the motion if carried. The whole matter would assume an altogether different shape. Would not the effect be to dissolve the committee?

Mr. W. H. Baines thought the motion would be a very serious difficulty in the way of giving an international character to the memorial. Cyrus Field's name had been mentioned, and he thought it would be rather offensive to the people of the United States to withdraw it now. He thought it would be best that leading men only should be connected with the memorial. If one went further, a very great number of names would have to be included.

Mr. Wm. Andrews said the original idea of the general committee in assisting in the memorial was, that it should be very much limited to the names of Sir John Pender and Sir James Anderson.

From the first, the speaker could scarcely see that other names could be associated with it, unless one went very far afield, for the names of those connec'ed with the inception and carrying out of submarine telegraphy were legion. It is always found that there are numbers of individuals who make almost simultaneous discoveries of those things which take their place in the work of the world. The first really practicable cable was that laid between Dover and Calais in 1851. The Atlantic cable laid in 1857 was not a reason for making this a memorial to commemorate next year the inception and extension of submarine telegraphy. What he thought was, that it was desired to commemorate the original and energetic efforts of Sir John Pender to establish electric communication between this country, its colonies and dependencies, which has brought together the families of the world under the British flag. That enterprise had been crowned with success. It did appear to the speaker that the proper course to adopt was to limit the nature of the memorial. If not, he did not see who was to be excluded and who included. They were not celebrating the science of the enterprise either electrical or engineering. They were celebrating the enormous merit of a man who knew how to seize the time to bring this country into almost instantaneous communication with every part of the world. For all these reasons he would be glad to see a memorial more limited in its scope, and applied more particularly to those who had led in the great enterprises connected with the room in which they met that day.

Sir Robert Herbert felt that the committee having publicly brought forward a proposition for a commemoration of submarine telegraphy, he could not be content with a memorial to Sir John Pender only—entirely fitting as it was that he should be honoured in that way. As Mr. Lamb had told them, 1901 would form a cable jubilee, at a time when representatives of almost every nation would meet in London. Why should they not determine to establish an appropriate memorial to Sir John Pender now, and and prepare to record the jubilee of submarine telegraphy in 1901?

Lord Kelvin had read a great many letters on the subject in the *Times*, and had agreed with much that they contained. On the supposition that the proposal was for an international memorial of submarine telegraphy pure and simple, the present did not seem very suitable for a perfectly general and comprehensive memorial. Then again, the question of names was a most difficult one. If they begin to introduce other names their task would be endless. Suggestions had been made to go back to the very idea of electric telegraphs; again, to the first idea of telegraphing under water; and again, to the first telegraph which successfully worked between England and France. Others suggested the first attempt at a great ocean telegraph, and if we came to the first Atlantic cable successfully laid, a date considerably later than 1858 was reached. The noble Lord thought they were scarcely prepared to introduce so many names as must necessarily be done if one went so far back. If they were to think only of ocean telegraphy, and confined themselves to the names of those who had left us, the matter would be greatly simplified. Cyrus Field, Sir John Pender, Sir Charles Bright, who actually laid the first cable in deep water across the Atlantic, and next, Sir James Anderson, might be included. Considering all the circumstances and what they really could face, with the prospect of bringing it to a satisfactory conclusion, it seemed to Lord Kelvin the best thing to be done was to adopt the motion. They could consider what change in the wording was still necessary.

Mr. E. M. Underdown, Q.C., was extremely glad that the words referring to Sir John Pender in regard to telegraphy to the East and far East had been eliminated. Those working with Sir John, as he had done for 20 years, in Atlantic cables, knew that his services in Western telegraphy were very valuable indeed. Any testimonial should include the whole world of telegraphy. Mr. Bevan had asked whether this exclusion of other names would not alter the complexion of the whole matter, and Mr. Baines suggested that the exclusion of Cyrus Field's name would give offence in America. Sir James Anderson, if living, would have supported a memorial to Sir John, and he should have thought our friends across the Atlantic would not be angry at the exclusion of one name, because they have many other names which should be remembered. Perhaps the course recommended by Sir Robert Herbert would be the best. They should now confine themselves to a memorial to Sir John Pender, who had just left them, but that due provision should be made to meet the desire for a more general memorial.

Mr. John Newton would like to say that whenever Sir John Pender had to refer to the success of the Atlantic cable, he brought prominently forward the fact that it led to the possibility of the great work he accomplished in the East. He was glad the last clause of the motion had been withdrawn, and, with the knowledge that they were now only thinking of Sir John Pender, but with confidence that in 1901 he, and those associated with him in placing England at the head of submarine telegraphy, would be remembered, he would support the motion.

Viscount Peel said the motion now stood: "That a memorial be established to the memory of the late Sir John Pender, G.C.M.G., to commemorate the leading part he took in the establishment and commercial development of submarine telegraphy in its extension throughout the world."

Mr. J. Pendred said it appeared to be thought that the carrying of the motion would dissolve the committee. He had joined it under the impression that it was to promote a memorial to commemorate submarine telegraphy.

The Marquis of Tweeddale replied that it was agreed that the decision of the Executive Committee should be referred for confirmation to the General Committee.

Viscount Peel said the two propositions put into his hands were these: "That it is desirable to commemorate the establishment of submarine telegraphy by erecting at the present time a personal memorial to Sir John Pender." 2. "That provision be made in the year 1901 for a general international memorial, recording the Jubilee of Submarine Telegraphy."

Mr. F. A. Bevan asked what was meant by "a personal memorial?" D.d it mean a statue?

Sir Robt. Herbert said that was what was in his mind.

After some further conversation,

Viscount Peel said the first proposal would then be: "That it is desirable to establish a memorial to the late Sir John Pender, G.C.M.G., to commemorate the leading part he took in the establishment and development of submarine telegraphy, and in its extension throughout the world," for which 13 voted; to the contrary, none.

Viscount Peel put the second proposition, "That measures be taken for promoting, in the year 1901, of a general international memorial recording the jubilee of international submarine telegraphy," which was moved by Sir Robert Herbert, seconded by Lord Tweeddale, and carried unanimously.

The Marquis of Tweeddale proposed a hearty vote of thanks to Viscount Peel for presiding, and to Sir Robert Herbert for the assistance he had given the Committee in arriving at the decision to which they had come.

Mr. Underdown seconded the proposition, which was carried with acclamation.

A meeting of the full committee has been called for Tuesday next, to receive the report of the executive committee as to the resolutions passed, subject to confirmation, at the meeting of last Friday.

In addition to the names already published, the following have recently consented to join the committee:—

Sir Frederick Abel; Sir Alfred Dent; Sir James Sivewright; Alfred de Rothschild, Esq.; the Minister of Danish Posts and Telegraphs (Lieut.-Col. H. Hoencke); Captain W. H. Davies; Dr. J. A. Fleming; the Postmaster-General of Cape Town (Somerset R. French, Esq.); Henry Holmes, Esq.; Thos. Mackie, Esq.; George Royle, Esq. (Port Said); Dr. John Hopkinson; F. H. L. R. Moll, Esq.; and Dr. Wholey.

NOTES.

Electric Belts.—We cull the following from the last issue of *Science Siftings*:—"A correspondent sends us a circular issued by a Mr. J. H. Hodges. We know nothing to the discredit of this gentleman. He lays, however, special claim to recognition owing to the fact that he was formerly secretary of the Electropathic and Zander Institute, and for 12 years conducted the medical correspondence of the company. This is certainly no recommendation in our eyes, nor will it be, we should imagine, in those of the public who recollect the serious charges that were brought by the *Pall Mall Gazette*, the Electrical Review, and ourselves, against the Institute, and which ultimately resulted in closing its doors for ever. Our object in drawing attention to Mr. Hodges and his circular is to point out that he is vending the discredited Harness belts as 'health appliances,' and he tells his patrons 'if advice is desired, his long experience in electro-medical treatment is at your disposal free of charge.' We strongly advise Mr. Hodges to abandon this trade in these useless so-called electrical appliances, and to discontinue giving his electro-medical advice. He is treading on dangerous ground, and he will do well to return to the clerical work in which he appears to have graduated."

Telephone Relays.—The "New Telephone Discovery," which we recorded in our last issue (page 556), may, as the writer says, "be destined to be one of the next steps in electrical advance," but, in view of what has been done, or, rather, what hasn't been done, before, we may, perhaps, be excused for being sceptical on the point, this more especially as there is absolutely nothing in the description of what Mr. Patten states he has done, to indicate that he has solved the problem. Mr. Patten says:—"I distinctly heard speech in a second line that was automatically transmitted from the first by a repeating telephone relay, the speech being delivered in the second line with all the distinctness and certainty of ordinary telephonic transmission." Assuming that the relayed line was a section of the whole length, and not a second line running alongside the other (arranged for the experiment), as it might have been from the meagre description given, did the relay make the speech which was received without the relay more powerful? If it simply made the speaking equally good, but no better, what is the value of the invention? Relays are usually employed for the purpose of enabling working on long lines to be carried out, when without the relays working is impossible, or very bad. We shall look forward with interest to a more lucid and full description of what has been done.

Gas versus Electricity.—Mr. Dunning recently discoursed in the *Engineering Magazine* on the wonderful improvements that have been made in recent years in the economical production of gas. The use of the regenerative furnace has immensely reduced the quantity of fuel required to heat the retorts. Seventy-five per cent, of the coke produced can be sold, and may, in the vicinity of bituminous coal fields, suffice to pay the whole of the coal bill; on an average, he considers, it will pay 80 per cent. Not very many years ago the coal tar was looked upon as sewage, but now chemical research has evoked from it a series of valuable products, such as dyes of the aniline series, and invaluable medicines like phenacetine, and saccharin. The sale of the coal tar products, defrays 25 per cent. of the total coal bill. Other residual products, such as ammonia, still further reduce the cost of the principal product. Mr. Dunning sums up by saying that the gas, which contains about 20 per cent. of the total energy in the coal, is produced, in a modern gas works, from 20 per cent. of the fuel. Of course this refers only to the cost of the raw material, but it shows to what perfection the economical production of heat has been carried in gas works. Mr. Dunning remarks that "whenever by chance he happens to gaze at the chimney of an electric-lighting company, it touches a sympathetic chord in harmony with the feelings of the stockholders thereof, in the shape of a vision of dividends vanishing in smoke, worse than wasted, because an intolerable nuisance." Mr. Dunning's object, of course is to show that gas can hold its own against electricity for all time; but why should not electrical engineers learn a lesson from the enemy? In the gigantic central stations, which in the future will be built to supply large cities, the gas work may be combined with the present generating plant. If energy in the form of gas fuel can be produced at the same cost as energy in coal, it may, without doubt, be consumed in gas engines or burnt in steam boiler furnaces far more conveniently and economically. The possibility of adopting this plan will depend to a great extent on the demand for coke and other local circumstances, but we believe that for the large central stations of the future it may lead to considerable economies in the production of electrical energy.

Royal Institution.—A general monthly meeting of the members of the Royal Institution was held on 2nd inst., Sir James Crichton-Browne, Treasurer and Vice-President, presiding. After the election of members, the special thanks of the members were returned to the proprietors of the *Times*, Dr. Ludwig Mond, F.R.S., Prof. Dewar, and Sir Andrew Noble, for their donations to the fund for the promotion of Experimental Research at Low Temperatures. It was announced that the Christmas lectures, specially adapted to children, will this year be given by Prof. Silvanus P. Thompson, F.R.S., his subject being "Visible and Invisible Light." The managers have appointed Dr. Alexander Scott, M.A., D.Sc., to be superintendent of the Davy-Faraday Research Laboratory of the Royal Institution, the directors already appointed by the managers being Lord Rayleigh and Prof. Dewar. After the meeting the members inspected the new rooms which have lately been added to the library of the Royal Institution, through the munificence of Dr. Ludwig Mond, F.R.S., which rooms will provide increased accommodation for the members on the occasion of the Friday evening meetings.

Germany and Technical Education.—Lecturing last week at the County Borough of Bolton Technical School, Sir Philip Magnus referred to his recent visit to Germany. He is reported to have said that what the Germans have done to apply chemical science to industry they are now endeavouring to do in the applications of electricity, and hence their large outlay on electro-technic laboratories, which they have good reason to believe will prove a productive expenditure. Fifteen years ago there was no teaching of electric technology in any part of Germany to compare with that given in the Cowper Street Schools under the direction of the City Guilds Institute. And now England has no laboratories as complete nor attended by as many students as those recently erected in Darmstadt. The results of this teaching are shown in the general application of electricity to locomotion, to the transmission of power in mills and factories, to illumination, and other purposes.

Walter C. Johnson (Trading as Johnson & Phillips) v. Hanson, Scott & Co., Limited.—This arbitration, which involves certain points of interest to engineers, has, according to last week's *Engineering*, recently been decided upon by Mr. Jeremiah Head, M. Inst. C.E., Westminster. The plaintiff is a manufacturer of electric lighting plant at Old Charlton, Kent, and the defendants are makers of cotton driving ropes at Stockport. Towards the end of 1891 defendants undertook to supply a quantity of $1\frac{3}{8}$-inch diameter cotton driving rope, which should be suitable for certain conditions under which it was to work, and should not "fray or stretch quickly." In September, 1893, a further contract was entered into for an additional quantity of rope, on the same terms and conditions. The ropes were supplied and paid for. A year later, when they had been sufficiently used to test their capabilites, they were found, according to the contention of plaintiff, not to have fulfilled the contract conditions, and they were all rejected. Others were purchased, and the cost thereof, amounting to £120, was claimed as damages. Defendants contended that the ropes were good, and according to contract, and not properly rejected. The case was, in the first instance, brought before the Hon. Mr. Justice Wright, in the High Court of Justice, Queen's Bench Division, and after some evidence had been given, it was ordered to be tried before three arbitrators. In April, 1896, this order was varied, and Mr. Head was selected by the judge to be sole arbitrator, all questions of costs being, however, reserved. The arbitration was held a short time since at 47, Victoria Street, Westminster. Mr. H. A. Forman, instructed by Mr. G. Whale, solicitor, of 107, Cannon Street, appeared for the plaintiff, and Mr. H. P. Banks, instructed by Messrs. Rackham & Co., of Lincoln's Inn Fields, for the defendants. During the proceedings, which extended over four days, a number of technical witnesses were heard. Their evidence tended to show that the difficulties which led to the rejection of the ropes arose mainly from two causes, viz., first, the small diameter of the driven pulleys (2 feet 4 inches), relatively to the size of the rope ($1\frac{3}{8}$-inch diameter); and second, the fact that the man employed by the plaintiff to make the splices in the ropes first supplied was not sufficiently experienced in this class of work, and his splices were continually giving way. The ropes supplied by defendants under their second contract, which were also rejected, were spliced by their own man. In the result the arbitrator awarded the plaintiff half the damages claimed by him. With respect to the costs of the reference, it was ordered by the judge that each party should pay his own and half the arbitrator's fees.

The Mishap at Bankside.—On Thursday evening last week there was a failure in the supply of current in certain parts of the City for the space of three-quarters of an hour, causing a good deal of inconvenience to business houses, particularly restaurants and jewellers. A mishap with the plant at Bankside was responsible for the failure. Some alterations have been in hand for many months, and these being unfortunately somewhat delayed, a temporary difficulty was caused in the running, but we understand that rapid progress is now being made in completing further machines, some of which have been put to work since the accident.

Lecture.—The fourth of the series of lectures on electricity was, on 27th ult., delivered at the Vestry Hall, Hampstead, by Mr. A. H. Fison, D.Sc. (London). The subject of the lecture was "Heating and Luminous Effects of the Current."

Correction.—With reference to our note last week regarding Mr. Pickstone, that gentleman asks us to correct a slight error respecting his appointment as electrical engineer to Messrs. P. R. Jackson & Co. He was not Dr. Edward Hopkinson's principal assistant, nor did he design the Snaefell plant, but he has been with Messrs. Mather and Platt for several years, and has been engaged directly under Dr. Hopkinson in the design and construction of the newer forms of electric machinery now coming into use, including special types for motive purposes in traction, factories, print and bleach works, multiphase transmission plant, transformers, &c.

Influence of Static Charge on the Surface Tension of Water.—The following is an abstract printed in the *Electrical World* of a paper on "The Influence of a Static Charge of Electricity upon the Surface Tension of Water," contributed by E. L. Nichols and J. S. Clark to the recent meeting of the American Association for the Advancement of Science. In this paper are described experiments upon the size of the drop delivered by a water dropper at different electric potentials. The phenomenon which was looked for was a diminution of the size of the drop with increase of potential. The effect of an electric charge upon a water jet is well known, and the phenomenon is one which is most readily explained by a diminution in the surface tension of the liquid. So far as known to the writers, however, no quantitative measurements touching this point have been made. It is the object in this investigation to obtain direct evidence of the electric charge upon the surface tension. The method consists in weighing the water collected from a glass dropper when the liquid is at zero potential, and when it is maintained at various high potentials by means of the action of a Holtz machine, driven at constant speed by an electric motor. Potentials were measured by means of a modification of the repeated ball electrometer. After many trials a form of water dropper was obtained, by means of which the average deviation in determinations of the drop taken by weighing groups of 20 drops varied from the mean of 16 such weighings by less than 1,001. By means of weighings of the drop, when the dropper was charged to voltages varying between zero and 11,000 volts, the data were obtained from which the tension could be computed as a function of the potential. Temperatures were carefully measured by means of a thermo-element, and all weighings were reduced to a standard temperature. The results obtained show that the surface tension diminishes slowly at first with increase of potential, then more rapidly until at 11,000 volts it is reduced to zero.

Electric Cabs and Carriages.—According to the daily Press, Mr. Radcliffe Ward is giving his attention to an electrically driven cab for the London service, and on Sunday last there were trial trips of an electric waggonette, with seats for 12 passengers. Its length is about 8 feet, and it is mounted on four pneumatic wheels. These wheels are about 2 feet in diameter, and the wheel base about 3 feet from centre to centre, so that it will turn easily in about its own length. Its total weight, including the accumulators, is 1 ton, which gives 5 cwt. pressure on each wheel. We are informed by the daily Press that the old accumulator cells were 12 inches × 8¾ inches × 6 inches, and their weight per cell was 56 lbs. Those used on the present vehicle were 10 inches × 8 inches × 3 inches, and the weight 24 lbs. per cell. The new carriage carries power equal to from seven to eight horses for three hours. It will most probably be seen amongst the competitors in the first long journey race under the new law on the 14th. But its primary object, we are told, is to supply the data for an electric-driven cab for London service. The trial runs have been made in the Horse Guards Avenue and the vicinity of the Embankment, where the vehicular traffic is at present very brisk by reason of the blocking of Parliament Street for renewal of wood pavement. But why does not Mr. Ward devote his attention for the present fully to the solution of the electric 'bus problem, instead of going off on to the cab question. And surely the data upon which Mr. Ward based his estimate of 2½d. per 'bus mile could have been made use of for a cab without experimenting with waggonettes. The electric omnibus will require a great deal of consideration yet, in spite of the promise of an early 200 of them.

Fire.—Yesterday week, during the performance of "The White Silk Dress" at the Prince of Wales's Theatre, Haymarket, the electric lamps were extinguished, and fire was discovered coming from behind the switchboard. The fact was kept from the audience, and there was little excitement. The officials put out the fire, and the management set the minds of the public at rest. The switchboard is, we understand, situated only a few yards from the visible portion of the stage, and "there can be no doubt," says a daily paper, "that the wires had fused and ignited the woodwork behind."

Atmospheric Influences on the Magnetic Survey of Mines.—After all the costly lessons that have been received by colliery owners to the effect that for underground work the magnetic survey is not to be relied on, the fact remains that the loose needle is still extensively employed for some of the most important of that work. And it is the consideration of this circumstance that leads H. W. Halbaum to recount, in a recent issue of the *Colliery Guardian*, pp. 442, 443, a somewhat remarkable experience, which for some time appeared quite inexplicable, and which remains inexplicable still, unless we accept the theory that atmospheric conditions explain it. So far as the author is able to ascertain, such a theory has not before been enunciated with any practical reference to the surveying of mines. Hitherto, he has published no account of the experience referred to, because, although he felt convinced that atmospheric conditions had something to do with it, he was unable to formulate any satisfactory theory by which such a conviction might be justified. The bulk of the paper is concerned with a detailed account, with diagrams of an actual case observed by the author. For this our readers must consult the original paper, as it is not adapted to condensation. In explaining this case, the view taken is that the cumulative power of the various atmospheric influences may be competent to cause serious errors of survey where the loose needle is too implicitly trusted. It is, no doubt, easy to raise objections to that view. It cannot be denied that temperature does affect a magnetic needle; it cannot be doubted that one form of energy possesses a mysterious influence of some kind over other forms, and nothing seems more certain than that electrical stress and electric currents are actual phenomena in a mine. Some might suppose that the influence of one set of phenomena is likely to counteract or counterbalance the influence of another set—*e.g.*, the power of one electrical current to deflect the needle in any given direction may exactly equal the power exerted by another current to deflect it in the opposite direction. But it appears likely that the set of these currents will be to some extent dependent on the magnetic meridian, to some extent on the direction of the ventilating current, and to some extent on other constant factors. This consideration points to the probability that the currents generally will ultimately assume a common determinate direction; and if this general agreement in the direction is once granted it is impossible to see how the supposed balancing of the deflecting agencies can be effected. At any rate, the fact that we are not very able to measure the danger scarcely justifies us in shutting our eyes to the fact that the danger actually exists. Indeed, apart from the abstract theory enunciated by Halbaum, the concrete example which he quotes shows the danger to be of some magnitude, and one that forms a serious count in the already too serious indictment of the loose needle as an instrument of modern mining survey.

The Submarine Telegraph Memorial.—Touching the report of last Friday's meeting at Winchester House, which we publish in another place, it certainly seems to us that Mr. Bright was but describing the case correctly in the ending of his original amended form of title for the memorial. Certainly the part played by Sir John Pender became most conspicuous in regard to the establishment of communication with the East and far East. His previous association with Atlantic telegraphy was of a less leading nature, and was, in the main, characterised by his having the foresight to stake a sum of money in the second Atlantic cable, along with ten other promoters, composed mainly of directors of the Telegraph Construction Company, the first appealed to being Mr. Thomas Brassey, and the second Sir John himself, its first chairman. It must not be lost sight of that Sir John was not amongst those to receive honours in connection with these early Atlantic cables; his services were recognised many years later, more particularly for the pre-eminent part he took in the establishment of submarine telegraphy to our Eastern colonies.

Thermal Conductivity of Sheet Copper.—"Thermos," writing to *Engineering*, asks:—"Can you or any of your readers inform me where I can find reliable data as to the rate at which heat is transmitted through sheet copper of various thicknesses, and with various values of $(T - t)$, which, in the case with which I am dealing, will vary from 20° to 50° Fahr.?"

Dynamo Brushes.—The article from the *American Electrician*, which we conclude in another column, on the selection of dynamo brushes, their proper contact area and commutator pressure, is, says our contemporary, believed to contain the most complete consideration from the practical standpoint of the subjects treated that has yet appeared in print. Heretofore, much of the information on these points has been of the indefinite kind which is useless to both the theoretical and practical man. What the latter wants are precise statements that will enable him to determine numerically the exact data for a given machine; what he is usually offered are discussions on the theory of sparking, &c., and told that if the pressure of the brush on the commutator is too great there will be cutting, while if too small there will be sparking, and so on. Mr. A. E. Wiener's article, on the other hand, gives formulæ by means of which the cross-sections of brushes and commutator pressure may be simply calculated for any given condition, the results being expressed in square inches and pounds, and requiring a mere knowledge of arithmetic for their application. To illustrate the application of the formulæ numerical examples are given under each.

A Curious Phenomenon.—Telegraphy by electric search light is, we are informed by a correspondent, established and regularly worked on fine nights between Port Louis and Mahebourg (Mauritius), a distance of 20 miles. A peculiar effect of the projector ray was noticed by an observer one night in September last. He was stationed at Quatre Barnes, a town intermediate between the two points holding communication, but screened from the direct rays of the lamp in the fort at Port Louis by a range of hills. It was a cloudless night, and when the ray was sent in his direction, it lit up the windows of his apartment. The illuminating ray could not, for reasons already given, have been direct, and it is consequently surmised that its path was deflected in some peculiar manner through the atmosphere through which it passed.

Electricity and the Ballet.—The public are now familiar with the wonderful theatrical effects that can be produced by electricity, but the demonstration that is given every night at the Empire in the ballet of Monte Christo of the applications of incandescent electric lamps surpasses anything we have ever seen on the stage. Gorgeous electrical effects are produced towards the end of the ballet in the cave scene; the dresses of the coryphées (we think that is the right name), are loaded with electric lamps, and as connection is made on the stage by means of wands, they are lighted up most brilliantly. In this scene, the number of electric lamps that are employed is computed at 7,000. The lamps are of the reflecting type, made by the Improved Electric Glow Company, Limited, and the company is to be congratulated upon being associated with such a wonderful production as the ballet of Monte Christo.

The Cyanide Process Case.—Judgment was given at Pretoria on Wednesday in the action brought by Mr. James Hay against the African Gold Recovery Company to decide whether the patent rights of the company in the MacArthur-Forrest gold extraction process, generally known as the cyanide process, are valid in South Africa. The decision is in favour of the plaintiff, with costs. Patents 47 and 74 are set aside on the ground of want of novelty.

Electricity in Japan.—The following note recently appeared in the *Indian Engineer*:—

During the past few years the applications of electricity have been very much developed in Japan, and in order to regulate the various projects which are being carried out, the Minister of State for Communications has issued regulations which must be observed. They are rather lengthy, but appear to be of a practical nature, and not likely to hinder any reasonable developments. An electric tramway is being constructed in Tokio, and many of the waterfalls in the country are being utilised for the purpose of generating power. The telegraph system of the country has been very complete for a good many years; but now there is evidently a boom on for telephones, which are being extended to all parts of the country. In fact, in the matter of telegraphs and telephones, it is probable that in some respects Japan is further advanced than Britain. The Japanese are, however, evidently not content with the progress which has been made, and have despatched a commission of electrical experts to America for the purpose of studying all the most recent developments in that country, so that they may be utilised in Japan. Somehow or other the Japanese have the knack of appropriating the best of all Western advances, and it is a curious problem to watch the result.

Appointments Vacant.—"Alpha" advertises in the *Financial News* for a mine manager, to take charge of a gold mine in West Australia:—

He must be well up in the most modern surface and underground equipment of mines. Must have thorough knowledge of engines, boilers, compressors, mining, and electrical machinery. Must understand the cyanide and chlorination processes for treatment of tailings, and be responsible for design of work, preparation of plans and estimates, and must supervise erection of all plant and machinery, construction of buildings, &c. Only gentlemen with good mining and mechanical experience need apply. Age should not exceed 40. Liberal salary will be paid.—Address Alpha, care Davies & Co., Advertising Agents, Finch Lane, Cornhill.

The Birmingham Public Works Committee want an "electric inspector" at £200 per annum, and an "assistant electric inspector" at £78 per annum. For further details see our "Official Notices."

A qualified engineer with a knowledge of electric lighting plant is wanted for the District Asylum, Mullingar, at £70 per annum.

Made in America.—There is one point which has occurred to us since our leading pages went to press. If the McIntosh & Seymour engine is not a moderate steam consumer, this importation from the States may not in the long run do English engineers much harm, for in the sweet by and bye it will be to their advantage, rather than otherwise, to show what they can do in comparison with the engines soon to be running at Bristol.

Metropolitan Tramways.—The discussion at the London County Council on the question of the purchase proposals of the Highways Committee, revealed the fact that "electric traction" is, in the opinion of several members, the "controlling influence." The consideration of the Highways Committee's report was postponed in order that the Finance Committee might give its reasons for disagreeing with the recommendations. We do not quite see why the Committee should not purchase the tramways in anticipation of their surrendering dates without making the same contingent on a working lease. The separation of these two conditions would seem to be of advantage to the Council and to the "controlling interest"—electric traction.

Gas Engines and Electric Lighting.—Mr. H. O'Connor, A.M.I.C.E., in the first of a series of lectures delivered at the Heriot-Watt College, Edinburgh, on 28th ult., on "Gas Manufacture and Appliance," pointed out that it would be cheaper to make electric light by converting the coal into gas and turning it into power by means of gas engines, and afterwards to utilise the residual coke for the purpose of raising steam, than to place the coal direct into boilers and convert the steam into power direct. The former method, he states, will show a saving of 50 per cent.

Electric Tramways and Gas Mains.—At Toulon, at Granville, and at Saintes, in France, a very great deal of trouble, says the *Gas World*, is being taken by the electric tramway and electric people in order to give all gas mains as wide a berth as possible. "At Melun there is great anxiety about the escape of current from the wires to the gas pipes, an anxiety which has not been alleviated by a simultaneous outbreak of fire in three places in the town from this cause, the insulation of the wires having been set fire to by the short-circuiting."

Engineering Progress.—On Tuesday night Mr. J. Wolfe-Barry, C.B., F.R.S., delivered his presidential address before the Institution of Civil Engineers in the new premises in Great George Street. He surveyed retrospectively the general progress with which engineering had been, and was, intimately connected. His remarks were particularly devoted to railway development, transit by sea, post office work, sanitary engineering, water supply and gas, electrical work (traction in particular), light railways, and the expansion of the Institution.

Personal.—We learn that Mr. R. T. Turnbull is temporarily in charge of the New Zealand Electrical Syndicate's supply station in Wellington during Mr. A. J. Suckling Baron's absence in England.

Presentations.—At the Blackpool Electricity Works Mr. Hill, who is leaving to take the position of chief assistant at Malaga, Spain, was presented by his fellow officials and workmen with a silver flask, silver cigarette case, and silver matchbox.

Mr. Gamlen, who has been connected with the Blackpool Electricity Works since their commencement, is also leaving to enter the employ of the British Insulated Wire Company, and he was the other day the recipient of a spirit cabinet and a carriage clock.

Subways for London.—The proposal of Mr. Emden for providing an elaborate system of subways and occupation vaults beneath the City streets to carry water, gas and electric light mains, to prevent the opening up of the streets, came before the London County Council again on Tuesday. We have already referred to this proposal. The matter was ordered to stand over.

The Northern Society of Electrical Engineers.—At the Ordinary General Meeting to be held on Tuesday, November 10th, 1896, a paper on "Cheap Steam Power" will be read by Mr. John S. Raworth, member. This ought to give "Universal" satisfaction.

Royal Society.—It is stated that Lord Rayleigh has intimated to the Council of the Royal Society that he does not intend to seek re-election as one of the joint secretaries of the Society.

Water-Power.—An application has lately been made for a concession to put down and operate plant to utilise the water-power of the Danube, at some falls near the Iron Gates. It is estimated that 10,000 H.P. is available.

Photography in Data Collecting.—Writing to the *Electrical World*, Mr. Fessenden advocates photographic means of keeping up a scrap-book. He tried the system of a card index for three years, and proclaims this method as the best for a hand kept record. He now uses a photographic method. His camera has lens of $\frac{1}{4}$-inch aperture, and a focus of $1\frac{1}{4}$ inch. It thus embraces a wide angle, and is very rapid, and needs no focussing for distances beyond 2 feet. With this camera he copies letters and pages of matter out of journals. The exposure in daytime is one-tenth of a second. The plates are put away until there are a number of them, when they are developed for five minutes, fixed for the same time, and stood an hour in pure water. Each plate is $1\frac{1}{4} \times 1\frac{1}{2}$, and will contain 2,000 words, and as 400 or 500 words, as a rule, are as many as one needs to copy, the negative can be read in such cases without a glass. As to cost, each small plate costs one-sixth of a penny, and each finished plate does not exceed a farthing. For machinery photographing he uses a camera taking $3\frac{1}{4} \times 4\frac{1}{4}$ plates. To give an idea of what photography can do, he states that upon a plate only 1 inch square, there could be printed 50 years of the leading matter of our contemporary at the rate of 32 pages per week, of 2,000 words each. He suggests the possibility of the future library being read by means of a small projection lantern from a series of plates, purchased at a fraction of the present cost of books. The proposition is infinitely better than that of the phonograph cylinder, for it would require five years to speak the words that could be contained on a square inch of glass. The ease with which, by pressing a couple of keys, the plate containing a whole dictionary could be brought to position for any page to be thrown on the screen, is rather enticing. To be able to travel over the world with several thousand volumes in a handbag is distinctly good to contemplate. The thing is not impossible. There lies before us, as we write, a Swiss made penholder. In its carved handle is set a bead of glass, nearly $\frac{1}{8}$-inch diameter. Upon a flat side of the bead is visible a little square about $\frac{1}{32}$-inch or less. This little rectangular patch contains a view of Murren, with houses, mountain sides, glaciers and ravines, visible in fine detail when held to the light. The area visible must be many score acres, and the 50 years' volumes would barely measure seven acres, while if only reduced one-twentieth of the proposed diameter ratio, a box of 1 foot cube would hold a 50,000-volume library. There is a large field for inventive genius scarcely touched as yet.

Correction.—We are informed by Dr. Max Einhorn that the annual gathering of the American Electro-Therapeutic Association was held in Boston, and not in New York.

NEW COMPANIES REGISTERED.

International Telescriptor Syndicate, Limited (49,860).—Registered October 27th with a capital of £10,000, in £1 shares, to acquire the patents and inventions of B. Hoffmann for all countries of the world (other than Great Britain and the British colonies and dependencies), relating to telegraphic apparatus and to typewriting machines, to enter into a certain agreement, and to carry on the business of telescriptor, veloscriptor, telephone and telegraph company. The subscribers (with one share each) are: C. M. Owen, 11, Victoria Street, S.W., solicitor; J. A. Fraser, 4, Springfield Road, Wimbledon, solicitor; J. Blair, 30, Eardley Crescent, Earl's Court, S.W., clerk; A. J. Tod, 14, Hetherington Road, Clapham, accountant; G. H. Kirk, 22, Ashchurch Park Villas, W., clerk; B. Hoffmann, 10, rue Chanchat, Paris, ingenieur; P. Hoffmann, 152, Palmerston Buildings, E.C., architect. Table "A" mainly applies. Registered by Faithfull & Owen, 11, Victoria Street, S.W.

O. Berend & Co., Limited (49,875).—Registered October 28th with a capital of £20,000, in £1 shares, to enter into an agreement with O. Berend & Co., and to carry on the business of electrical, mechanical and general engineers, and manufacturers, bankers, financiers, builders, carriers, printers, &c. The subscribers (with one share each) are:—O. Berend, Dunedin House, Basinghall Avenue, E.C., engineer; A. Landor, Dunedin House, Basinghall Avenue, E.C., merchant; A. Haywood, 5, Lime Street, E.C., merchant; J. B. Salvat, 52, Warlock Road, Paddington, W., clerk; C. H. Gregory, 36, Vaughan Road, Camberwell, gentleman; R. L. Fricker, 22, Sidney Road, Stockwell, engineer; W. B. Glascott, 11, Sinclair Road, Kensington, W., clerk. The number of directors is not to be more than seven; remuneration as the company may decide; qualification one share. Registered by O. Berend & Co., Dunedin House, Basinghall Avenue, E.C.

Continental Water and Electrical Power Syndicate, Limited (49,882).—Registered on October 28th, with a capital of £26,000 in £1 shares, to enter into an agreement, dated July 28th, with Cavalierie Robecchi Guiseppe and Mario Azari, and with Della Beffa, and to carry on the business of a water supply company, an electric light and power company, and electricians, mechanical engineers, suppliers of electricity, &c. The subscribers (with one share each) are:—C. Luff, Woodham, Addlestone, Surrey, clerk; C. C. Wells, 1, Millfields Road, Clapton Park, N.E., clerk; S. E. Newman, 72, Romilly Road, Finsbury Park, N., clerk; E. Sorrell, 50, Idmiston Road, Stratford, E., clerk; G. Beeson, 2, Clarendon Terrace, W., clerk; A. Blackman, 18, Argyle Square, W.C., solicitor; F. Morton, 4, Bidwell Street, Peckham, S.E., clerk. The number of directors is not to be less than two nor more than seven; the subscribers are to appoint the first; qualification 100 shares; remuneration £100 each per annum. Registered office, 11, Old Broad Street, E.C.

Leatherhead Electric Lighting and Power Company, Limited (49,945).—Registered October 31st with a capital of £1,000, in £5 shares, to carry on the business of suppliers of electric light, heat, and power, electricians, electrical and mechanical engineers, fitters, machinists, &c. The subscribers (with one share each) are: C. F. Croll, 51, Barrington Road, Brixton, gentleman; G. Shenton, Prince's Chambers, Coventry Street, S.W., gentleman; T. O. Dear, 51, Queen's Square, S.W., gentleman; E. S. Edgecombe, 2, Gloucester Villas, Beckenham, gentleman; A. Cochrane, Copthall House, E.C., gentleman; A. W. Wells, Lyndewoode, Greenhill Park, Harlesden, accountant; J. A. Lloyd, 4, Lancaster Road, Upper Tollington Park, gentleman. Registered without articles of association by J. L. Higgs, 3, Delahay Street, S.W.

Walton-on-Thames Electric Lighting and Power Company, Limited (49,948).—Registered October 31st, with a capital of £1,000 in £5 shares, to carry on the business of suppliers of electricity, electricians, mechanical engineers, electrical apparatus, manufacturers, &c., and to use or manufacture and put up telephones, telegraphs, electric bells, &c. The subscribers (with one share each) are:—C. F. Croll, 51, Barrington Road, Brixton, gentleman; G. Shenton, Princes Chambers, Coventry Street, S.W., gentleman; T. O. Dear, 51, Queen's Square, S.W., gentleman; E. S. Edgecombe, 2, Gloucester Villas, Beckenham, gentleman; A. Cochrane, Copthall House, E.C., gentleman; A. W. Wells, Lyndewoode, Greenhill Park, Harlesden, accountant; J. A. Lloyd, 4, Lancaster Road, Upper Tollington Park, gentleman. Registered, without articles of association, by J. L. Higgs, 3, Delahay Street, S.W.

Rottingdean Electric Lighting and Power Company, Limited (49,947).—Registered October 31st with a capital of £1,000, in £5 shares, to generate, produce, store, accumulate, and distribute electricity, electromotive force or other similar agency, and to carry on the business of electricians, mechanical engineers and electrical apparatus manufacturers. The subscribers (with one share each) are:—C. F. Croll, 51, Barrington Road, Brixton, S.W., gentleman; G. Shenton, Princes Chambers, Coventry Street, S.W., gentleman; T. O. Dear, 51, Queen's Square, S.W., gentleman; E. S. Edgecombe, 2, Gloucester Villas, Beckenham, gentleman; A. Cochrane, Copthall House, E.C., gentleman; A. W. Wells, Lyndewoode, Greenhill Park, Harlesden, accountant; J. A. Lloyd, 4, Lancaster Road, Upper Tollington Park, gentleman. Registered without articles of association by J. L. Higgs, 3, Delahay Street, S.W.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Consolidated Telephone Construction and Manufacturing Company, Limited (15,212).—This company's annual return was filed on October 13th. The capital is £234,938 divided into 47,363 £1 preference, 75,150 £1 ordinary, and 224,850 10s. ordinary shares. All of the last named class have been taken up, the full amount called, and £112,425 paid.

Walsall Electrical Company, Limited (37,696).—This company's annual return was filed on September 24th. The capital is £10,000, in £10 shares; 683 shares have been taken up, 200 are considered as paid, and £4,830 has been paid on the rest.

Electric Construction Company, Limited (39,292).—This company's annual return was filed on September 29th. The capital is £400,000, in £2 shares (of which 50,000 are preference). 110,000 ordinary and 16,343 preference have been taken up, and all the ordinary and 13,145 preference are considered as paid; £2 per share has been called on 3,198 preference, and £6,366 has been paid.

Williamson & Joseph, Limited (47,131).—This company's statutory return has just been filed; 5,000 shares have been taken up out of a capital of £10,000, in £1 shares, and are considered as paid. The registered offices have been removed from 92, Queen Victoria Street, E.C., to 65 and 66, Chancery Lane, London, W.C.

London Electric Omnibus Company, Limited (47,990).—This company's statutory return was filed on October 9th. The capital is £250,000 in £1 shares (of which 80,000 are deferred); 50,007 ordinary, and 80,000 deferred, have been taken up, and the latter are considered as paid; 10s. per share has been called on 50,000 and nothing on the others; £24,947 5s. has been paid, and £52 15s. is in arrears.

CITY NOTES.

Roller Bearings Company, Limited.

The statutory general meeting of this company was held last week at 1, Delahay Street, Westminster, under the presidency of Major-General C. S. Hutchinson, C.B.

The Chairman said that the directors reported with much satisfaction that the whole of the share capital issued to the public had been subscribed, and the first call, which was made on September 7th, was promptly paid in every case, which they regarded as an evidence of confidence in the undertaking. Since the allotment was made further important experiments have been made with the bearings, with completely satisfactory results, and as an example of this it may be stated that upon the Liverpool Overhead Electric Railway it was demonstrated that a passenger train of three coaches, fitted throughout with the company's roller bearings, was able to do the same work in the same time, and with the expenditure of the same amount of electrical energy, as a train of two coaches fitted with ordinary bearings; and as the outcome of this experiment the company has received orders to fit other trains with the bearings. Inquiries had also been received from such important centres as Edinburgh, Croydon, Burnley, Nottingham, Worcester, Hull, Birkenhead, India, Western Australia, South Africa, and Belgium. The bearings are at present being fitted to the largest bell at St. Paul's Cathedral, London, known as Great Paul, and it is hoped that further business in this direction may be obtained. Further trials are about to be made with the bearings fitted to a main line bogey carriage upon one of the principal London railways on which the bearings hitherto have been fitted only to an ordinary train of a few coaches; they are now to be fitted to a main line express carriage, with a view to seeing how they behave when running on express trains.

British Electric Traction (Pioneer) Company, Limited.

An extraordinary general meeting of this company was held yesterday at Winchester House, to pass a resolution approving a contract for the sale of the company's undertaking and assets to the British Electric Traction Company, Limited, and also to fix the remuneration of the directors. Sir Charles Wilson presided, and said that though the company had only been in existence some 12 months, he thought they could congratulate themselves on the business they had done in that time. They were now going, with the consent of the shareholders, to extend the company. The new company would be practically the same as the present, but with an extended sphere of work; it would retain the same name with the absence of the word "Pioneer." The terms upon which the business of the Pioneer Company would be transferred will be the payment to the new company of £25,000. The resolution was unanimously adopted, and the directors' remuneration was fixed at £1,000.

The Western and Brazilian Telegraph Company, Limited.

The report of the directors, to be presented at the thirty-second ordinary general meeting of the company, states that the total earnings amount to £71,082 4s. 9d., as against £84,936 16s. 11d., a decrease of £13,854 12s. 2d. compared with the half-year to June 30th, 1895. The loss of revenue for the half-year, as compared with the corresponding period, is owing to the diminution of the internal traffic of Brazil, probably occasioned by the disturbed state of commercial affairs. The working expenses amount to £37,428 9s. 1d., as against £37,891 9s. 6d., a decrease of £463 0s. 5d. Including the amount brought forward from 1895 (£4,952 13s. 7d.), the balance to the credit of the revenue account is £38,606 9s. 3d., from which has to be deducted £10,750 10s. for debenture interest, £5,000 for the debenture redemption fund, £1,719 2s. 8d. for income-tax, and £3,000 placed to reserve fund. The directors now recommend the payment of a dividend, free of income-tax, for the half-year at the rate of £2 per cent. per annum, as against £2½ per cent. per annum for the corresponding period, carrying forward £3,530 5s. 7d. This dividend will be payable as follows, viz., 3s. per share to the ordinary shares, and 3s. per share to the preferred ordinary shares. There is no change in the position of affairs between the Government of Brazil and the company as to the acquisition of the cables. The conversion of ordinary shares into preferred ordinary and deferred ordinary shares is suspended until further notice. The dividend warrants will be posted on the 13th inst.

The City of London Electric Lighting Company, Limited.—Mr. J. Cecil Bull (the manager and secretary) sends us the following returns relating to his company:—Revenue return, quarter ended September 30th, 1896:—Gross revenue from sale of current for public lighting, quarter ended September 30th, 1896, £3,158; corresponding quarter last year, £3,182; gross revenue from sale of current for private lighting, &c., quarter ended September 30th, 1896, £17,274; corresponding quarter last year, £11,600; gross revenue from other sources (estimated), quarter ended September 30th, 1896, £750; corresponding quarter last year, £400; total, quarter ended September 30th, 1896, £21,182; corresponding quarter last year, £15,182; increase, £6,000; equivalent of 8 C.P. lamps connected on September 30th, 1896, 228,740; increase during quarter, 13,181; equivalent of 8 C.P. lamps connected on September 30th, 1895, 170,827; increase during corresponding quarter last year, 11,577.

Chicago Edison Company, Limited.—The London Scottish American Trust, Limited, offer for sale an issue of $1,200,000 first mortgage 5 per cent. 30-year gold bonds, redeemable at the option of the company in April, 1911, or any year thereafter. The Chicago Edison Company is incorporated under the laws of the State of Illinois to supply electric light and power in Chicago. Dividends at the rate of 8 per cent. per annum have been paid in cash since the year 1889 upon the capital stock issued. The amount of stock now issued is $4,973,437.50, the market price of which is 117 per cent. The net earnings for the year ending March 31st, 1896, amounted to $531,020.37. The list of applications closes to-day, Friday. Mr. Samuel Insull is the president of the company.

Brush Electrical Engineering Company, Limited.—An extraordinary meeting of this company was held on Monday at Cannon Street Hotel, Mr. Braithwaite in the chair. The resolution passed at the annual general meeting, reducing the ordinary shares, was unanimously carried, but shareholders present were asked to declare their vote formally, so as to be quite in order when the application was taken to Court. The chairman stated that previous to the meeting holders of 56,000 shares had declared in favour of the motion, holders of 60 having declared against.

Stock Exchange Notices.—Application has been made to the Stock Exchange Committee to appoint a special settling day in, and grant a quotation to, Callender's Cable and Construction Company, Limited—£90,000 4½ per cent. first mortgage debenture stock, and City of Birmingham Tramways Company, Limited—40,000 cumulative 5 per cent. preference shares; and £300,000 4 per cent. first mortgage debentures. Also to appoint a special settling day in Electrical Development and Finance Corporation, Limited—10,227 shares, Nos. 1—10,227.

The Cambridge Electric Supply Company, Limited.—This company reports a considerable increase in the returns this year for the quarter from July 1st to September 30th. In 1895 the reserve amounted to £410 16s.; this year it was £530 9s. 7d. The number of units sold in the quarter for 1896 was 17,025, against 13,027 in 1895.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending November 1st, 1896, were £1,016; week ending November 3rd, 1895, £971; increase, £45; total receipts for half-year, 1896, £16,711; corresponding period, 1895, £15,648; increase, £1,063.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for the month of October, 1896, were £2,720.

The Liverpool Overhead Railway Company. The receipts for the week ending November 1st, 1896, amounted to £1,112; corresponding week last year, £1,046; increase, £66.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending October 30th, 1896, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brasilian Telegraph Company, Limited, were £2,988.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation, Oct. 28th.	Closing Quotation, Nov. 4th.	Business done during week ended Nov. 4th, 1896. Highest.	Lowest.
173,400£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	4 %	4 %	100 —104	100 —104	...	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	8½ — 9½	8½ — 9½	...	...
1,012,880£	Anglo-American Teleg., Ltd. ...	Stock	£2 11s.	£2 2s.	£2 9s.	50 — 53	51 — 54	52⅞	51
2,993,560£	Do. do. 6 % Pref.	Stock	£5 2s.	£4 4s.	£4 18s.	95½ — 96½	96 — 97	96⅞	95⅝
2,993,560£	Do. do. Defd.	Stock	...	...	...	9 — 9½	9½ — 10	9⅝	9
130,000	Brasilian Submarine Teleg., Ltd.	10	6½%	7 %	7 %	14⅝ — 15¼	14⅝ — 15¼	15⅛	14⅝
75,000£	Do. do. 5 %, Debs., 2nd series, 1905	100	5 %	5 %	5 %	112 —116	112 —116	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	...	2½%	4 %	3¼ — 3⅜	3¼ — 3⅜	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	145 —150	145 —150	...	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	2 %	1½%	1½%	1 1/16 — 1 3/16	1 1/16 — 1 3/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	11½ — 12½	11½ — 12½	...	...
5,000	Do. 10 % Pref.	5	4 %	4 %	4 %	18½ — 19½	18½ — 19½	...	...
12,931	Direct Spanish Teleg., Ltd.	5	10 %	10 %	10 %	3½ — 4½	3½ — 4½	...	...
6,000	Do. do. 10 % Cum. Pref.	50	...	4½%	4½%	10 — 10½	10 — 10½	10	...
80,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000	20	2⅝%	2 %	2½%	107 —110%	107 —110 %	...	...
50,710	Direct United States Cable, Ltd.	10	6½%	6½%	6½%	9½ — 9⅝	9 — 9½	9 1/16	9 5/16
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6 %	6 %	6	17½ — 17⅝	17½ — 17⅝	17⅝	17⅝
70,000	Do. 6 % Cum. Pref.	100	5 %	5 %	5 %	18½ — 19½	18½ — 19½xd	18¼	18⅛
102,100£	Do. 5 % Debs., repay. August, 1899	Stock	4 %	4 %	4 %	104 —107	104 —107	...	...
1,297,837£	Do. 4 % Mort. Deb. Stock Red.	10	7 %	7 %	7 %	131 —134	128 —131	129½	128½
250,000	Eastern Extension, Australasia and China Teleg., Ltd.	} 100	5 %	5 %	5 %	17½ — 17¾	17½ — 17¾	17 1/16	17 5/16
54,100£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5 %	5 %	100 —104	100 —104	...	...
194,300£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	Stock	4 %	4 %	4 %	101 —104	101 —104	...	...
720,000£	Do. 4 % Deb. Stock	} 100	5 %	5 %	5 %	130 —133	130 —133	...	...
80,600£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	5 %	101 —105	101 —105	...	...
107,600£	Do. do. to bearer, 2,344 to 5,500	} 100	4 %	4 %	4 %	102 —105	102 —105	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	25	4 %	4 %	4 %	106 —109	106 —109	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	10	4⅝%	4½%	4½%	110 —113 %	108 —111 %	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	6 %	6 %	6 %	10⅜ — 11½	10⅜ — 11½	11⅛	10⅜
180,042	Do. do. 6 % Pref.	10	8⅜%	8⅜%	10 %	17½ — 17⅝	17½ — 17⅝	17 9/16	17¼
150,000	Great Northern Teleg. Company of Copenhagen	100	5 %	5 %	5 %	24 — 25	24 — 25	24¼	...
180,000£	Do. do. do. 5 % Debs.	25	10 %	10 %	10 %	104 —107	104 —107	...	...
17,000	Indo-European Teleg., Ltd.	100	6 %	6 %	6 %	52 — 53	53 — 55	54⅞	54⅜
100,000£	London Platino-Brasilian Teleg., Ltd. 6 % Debs.	5	4 %	4 %	4 %	109 —112	109 —112	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000	5	5 %	5 %	5½%	2 — 2⅛	2 — 2⅛	...	...
484,597	National Teleph., Ltd., 1 to 484,597	10	6 %	6 %	6 %	7⅛ — 7⅜	7⅛ — 7⅜	7⅜	7⅛
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	17 — 19	17 — 19	...	...
15,000	Do. 6 % Cum. 2nd Pref.	5	5 %	5 %	5 %	17 — 19	17 — 19	18⅛	18 1/16
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	Stock	3½%	3½%	3½%	6⅜ — 7	6⅜ — 7	6 13/16	...
1,100,000£	Do. 3½ % Deb. Stock Red.	1	...	4½%	5 %	106 —109	106 —109	108	105½
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	} 100	4 %	4 %	4 %	1 1/16 — 1 3/16	1 1/16 — 1 3/16	...	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	8	0 %	nil	5 %	108 — 111	108 —111	111	...
11,839	Reuter's Ltd.	Cert.	...	...	...	7 — 8	7 — 8xd	...	...
3,381	Submarine Cables Trust	5	...	3 %	4 %	136 —141	136 —141	...	...
58,000	United River Plate Teleph., Ltd.	Stock	5 %	5 %	5 %	3½ — 4	3½ — 3⅝	...	...
146,732£	Do. do. 5 % Debs.	10	nil	nil	4 %	101 —106	101 —106	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	100	5 %	5 %	5 %	5 — 6	5 — 6	...	...
238,380£	Do. do. do. 5 % Debs.	10	nil	nil	nil	102 —105	103 —106	103½	...
38,000	West Coast of America Teleg., Ltd.	100	8 %	8 %	8 %	½ — 1½	½ — 1½	...	...
156,080£	Do. do. do. 8 % Debs., repay. 1902	15	2½%	3 %	3 %	98 —103	98 —103	...	...
54,248	Western and Brasilian Teleg., Ltd.	7½	5 %	5 %	5 %	7⅞ — 8¼	7⅞ — 8¼	...	...
33,129	Do. do. do. 5 % Pref. Ord.	7½	...	1 %	1 %	6¼ — 7	6¼ — 7	...	...
33,129	Do. do. do. Def. Ord.	100	6 %	6 %	6 %	1½ — 2¼	1⅝ — 2¼	...	...
165,200£	Do. do. do. 6% Debs. "A," 1880 Red.	100	6 %	6 %	6 %	103 —107	103 —107	...	...
206,400£	Do. do. do. do "B," do.	10	⅛%	½%	½%	103 —107	103 —107	...	...
88,321	West India and Panama Teleg., Ltd.	10	6 %	6 %	6 %	1⅛ — 1⅜	1⅛ — 1⅜	...	...
84,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11½ — 12	11½ — 12	11 13/16	11⅞
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	9½ — 10½	9½ — 10½	...	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,800	100	5 %	5 %	5 %	108 —111	108 —111	...	...
1,777,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds	$1000	7 %	7 %	7 %	110 —115	107 —112	110½	...
164,300£	Do. do. 6 % Ster. Bonds.	100	6 %	5 %	6 %	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	4½%	4½%	5 %	9½ — 10	9½ — 10	9⅝	9⅝
10,277	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277	5	5 %	5 %	5 %	7⅞ — 8¼	7⅞ — 8¼	8⅛	8
60,000	Do. do. 4½ % Deb. Stock Red.	Stock	...	...	4½%	114 —117	114 —117	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	5 %	5 %	16 — 17	16 — 17	16 9/16	16½
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	17 — 18	17 — 18	17¾	...
40,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	130 —135	130 —135	131	...
300,000	County of Lond. & Brush Prov. E. Ltg. Ltd., Ord. 1—22,475	10	...	...	nil	8½ — 9½	8½ — 9½	8⅝	8½
22,475	Do. do. do. 6% Pref., 40,001—50,000	10	...	...	6 %	13¾ — 14½	13¾ — 14½	14½	14
20,000	Do. do. iss. at 2 pm., all paid	10	...	...	...	5½ — 6½	7⅛ — 8½	...	...
10,000	*Metropolitan Electric Supply, Ltd., 101 to 50,000	10	2½%	3 %	4 %	13 — 14	13 — 14xd	13⅞	13⅛
49,900	Do. Ord., 50,001—62,500, iss. at £2 prem., £1 paid	10	...	...	...	3½ — 4	6½ — 7	3½	...
12,500	Do. 4½% first mortgage debenture stock	...	4½%	4½%	4½%	121 —124	121 —124	...	...
150,000£	Notting Hill Electric Lightg. Co., Ltd., Ord., 101-20,080	10	...	1 %	2 %	11½ — 12½	11½ — 12½	...	...
6,452	*St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	4½%	6½%	7½%	12 — 13	12 — 13	...	...
19,980	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	10 — 11	10 — 11	10½	10 7/16
20,000	Do. do. 4 % Deb. stock Red.	Stock	...	...	...	106 —109	106 —109	...	...
50,000	Do.	5	4 %	5 %	7 %	10 — 11	10½ — 11½	...	...
67,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000								

* Subject to Founder's Shares.

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

‖ Dividends paid in deferred share warrants, profits being used as capital.

§ Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation Oct. 28th.	Closing Quotation, Nov. 4th.	Business done during week ended Nov. 4th, 1896. Highest.	Lowest
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000...	3	5 % §	2½%	...	⅞— 1⅛	⅞— 1⅛	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 % §	3 %	...	1 — 1¼	1 — 1¼	...	...
125,000‖	Do. do. 4½ % Perp. Deb. Stock.	Stock	4½%	4½%	...	110 —113	110 —113	...	...
76,770	Do. do. 4½% 2nd Deb. Stock Red. ...	Stock	...	...	...	97 —101	97 — 101	...	...
9,104	Central London Railway, Ord. Shares	10	...	...	...	10 — 10½	10 — 10½	...	...
207,649	Do. do. do. £4 paid	10	...	...	...	4 — 4¼	4 — 4¼	...	...
630,000‖	City and South London Railway	Stock	1⅛%	1⅛%	1⅛%	50 — 52	50 — 52	...	...
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	3 % §	*nil*	*nil*	2 — 2½	2 — 2½	...	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	5	7 %	5 %	5 %	1¾— 2¼	1¾— 2¼	2 1/16	...
17,139¶	Do. do. do. "A" Shares 01—017,139	5	7 %	5 %	5 %	3 — 4	3 — 4	3½	...
100,000	Do. do. do. 4½% Deb. Stock Red. ...	Stock	...	4½%	4½%	103 —106	103 —106	...	...
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	*nil*	5 %	1½— 1⅝	1½— 1⅝	...	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	7 %	7 %	7 %	2½— 3	2½— 3	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	*nil*	...	⅛— ¼	⅛— ¼	...	...
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	*nil*	...	⅛— ¼	⅛— ¼	...	...
9,600‖	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	*nil*	*nil*	10½%	10½— 11½	10½— 11½	...	...
10,000	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	5 %	6 %	8 %	17½— 18½	17 — 18	17¾	...
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	7 %	18½— 19½	18½— 19½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	...	4½%	110 —115	110 —115	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	12½%	10 %	10 %	21 — 22	21 — 22	21⅜	21⅜
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	105 —108xd	105 —108	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	1 %	1½%	2⅜%	13 7/16— 13 9/16	13⅜— 13½	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	16⅞— 17⅜	16⅞— 17⅜	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	20 %	15 %	39 — 42	39 — 42	41	39
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	104 —107	104 —107	107	...
54,000‖	Waterloo and City Railway, Nos. 1 to 54,000, £6 paid ...	10	...	...	...	7⅞— 8¼	7⅞— 8¼	...	...

Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50 °/₀ for 1890.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0°/₀§; 1891—7°/₀§ 1890—8°/₀.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply Company, Ordinary of £5 (£4 paid), 8, £5 (fully paid), 9¼.
Electric Construction Corporation, 6 % Debentures, 103—106.
House-to-House Company (£5 paid), 4¼—4⅝.
Do. do. 7 % Preference, of £5, 8½—9.
Do. do. 4½% Debentures of £100, 109—111.
Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 10—10½; 1st Preference Cumulative 6 %, £5 (fully paid), 8—8½.
London Electric Supply Corporation, £5 Ordinary, ⅞—1⅛.
Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 7½—8.

* From Birmingham Share List.

Bank rate of discount, 4 per cent. (October 22nd, 1896).

SUGGESTIONS FOR PROSPECTIVE PURCHASERS OF ELECTRICAL MACHINERY.*

By WILLIAM BAXTER, Jun.

In selecting an electric machine for any purpose, it is very important that the size should be properly proportioned to the requirements of the case. The mistake that is almost universally made is to obtain a size that is entirely too small to do the work without overstraining. This mistake is caused by two reasons; the first of which is, that the purchaser labours under the impression that the smaller the machine the higher the efficiency, and the second that the manufacturer fears that if he should advise a larger one it would be taken as a proof that he does not believe his machines will do the work for which they are rated. As to the notion that the efficiency of the smaller machine will be the highest, it may be said that it is not in accordance with the facts, as the percentage of the applied energy that is utilised is very nearly the same at any rate of output, from the full load down to 50 per cent. If electric machines were like steam engines there would be no very great objection to the adoption of a small size, for then, in case of an overload, all that would happen would be that the machine would fail to answer to the excessive demand. If a steam engine is forced beyond its capacity it will slow down and with a sufficient increase of load will come to an actual stop, but it will not be injured in any way. With an electric motor the results would be very different; these machines will not slow down enough, with an overload, to give any indication of the actual condition of things, and in fact will keep on running until the load becomes so far in excess of what they are able to carry that the heat generated by the flow of the current through the wire will become so great as to burn the insulating covering and thus destroy them. In view of this, it must be evident to anyone that it is not wise to use a motor that is too small, or just large enough to do the work. The same thing is true of electric generators. The difference in the first cost would not be increased very much by the adoption of a larger machine and the cost of repairs would be greatly reduced, while the reliability of the service would be greatly increased.

In many cities the electric companies charge for the current according to the size of the motor, and, in such places, it is only natural that the smallest machine that can do the work should be used, so as to cut down the cost of current supply. But even under such conditions it is doubtful whether this course is advisable, especially as it would seem not impossible to obtain a reduction in the rates if it were shown that the motor was much larger than necessary to do the work and that this extra capacity was used so as to guard against burnouts in the few cases where the load might become abnormally high. In all places where the current charges are based on the actual consumption, as indicated by a meter, the size of the motor should be considerably above the actual requirements.

In selecting a generator for a lighting plant the same course should be followed. The common custom in such cases is to instal a machine of sufficient capacity to furnish the required current, and then provide an engine powerful enough when working at its rated capacity to run the generator at its maximum output. Better results would be obtained if the engine were proportioned so as to be able to develop the power required to do the average maximum work when running at the point of highest economy, and then select a generator of such size that it could carry with safety all the current that the maximum capacity of the engine could develop.

The efficiency of a generator, like that of a motor, is very nearly the same over wide variations of load; therefore, there is nothing to be gained by reducing the size to the lowest point, and on the other hand, much may be lost, as by such a procedure the average working rate may be brought so near to the ultimate capacity of the machine that it will greatly strain the insulation by the excessive heat generated, even if it does not actually reach the burning out point.

In the selection of the machine itself, it should be remembered that the capacity is arbitrarily decided by each manufacturer, and, therefore, machines of equal rated capacity, but of different makes may not be of actual equal capacity. The best way to decide this point is to test them under like conditions, that is, run them for the same length of time with the same current, and then see which one is the coolest, and take that one if in its mechanical features it is just as good as the other. All electric machinery will heat when working, and this cannot be avoided any more than we can prevent the heating of a steam engine cylinder, but the machine that heats up the least under the action of the same current will be of the highest efficiency, providing it is similar in construction. If the machine that runs the coolest is the largest it may not be the most efficient, and may heat up less on account of its greater radiating surface, but even if this is the case it will be the best one to take because the difference in efficiency between the machines of all the good makers is not very great, and, therefore, the one that keeps the coolest should be taken, as on account of the reduced temperature the insulation will be strained less, and as a consequence will last longer than the other.

The next point to be considered is the mechanical perfection, and this should be judged not only with reference to the perfection of the design, but also with regard to the ease of repairing, as well as the cost of the same. The vital parts of electric machines are, first, the armature; second, the commutator; third, the commutator brushes; fourth, the field coils, and, fifth, the shaft and bearings.

* From *Power* for October, 1896.

The armatures are made either in the shape of a drum or a ring; the latter type being the most substantial and used almost exclusively in large machines. The drum type still continues to be the most popular for small machines, especially motors, and if properly made will give very good service. The greatest weakness in armatures of this kind is in connection with the insulation over the ends, which is liable to be defective. This is the case when an excessive amount of wire is wound upon them, as is very often done by manufacturers who desire to obtain a large output from a small machine. Whether there is too much wire or not can be determined by the shape of the end of the armature; if it is round and looks very full, as if there were no room left for additional wire, it may be safely assumed that it is crowded, and will soon give out, but if the corner of the armature core is well defined, and the ends look as if there were an abundance of room, it may be depended upon that the insulation is strong and will not give out very soon. Besides the difference in the shape of armatures, there is also a difference in the cylindrical surface upon which the wire is wound. In some cases this surface is perfectly smooth and in others it is grooved like a cog-wheel. When the surface is smooth it is completely covered by the wire, the latter being held in its place by strips of hard fibre that are set into slots sawed into the armature core. When the surface is grooved the wire is wound in the grooves. The latter construction, as anyone would imagine, is the most substantial, but at the same time it is the most difficult to make perfect, so far as the insulation is concerned. On account of the grooves, there are a great many sharp corners on the iron core, and unless these are so well covered that the wire cannot cut through them, there is danger that before long the insulation will give out. The smooth core is the easiest to make perfect, and, on this account, is used by the great majority of makers of small machines, but the grooved armatures, when properly constructed, are the most substantial and the most durable.

The commutator, to give satisfactory results, should run without sparking, and to do this it is necessary that the various parts of the machine be in proper proportion with relation to each other, and, also, that the sections of the commutator be sufficient for the electromotive force of the machine, and that the construction be perfect; and that the proportions of the sections and the insulations between them be such as to insure equal wear of both, and thus preserve a smooth surface.

Whether the various parts of the machine are in proper proportion cannot be determined by a simple inspection, therefore all that can be done is to ascertain by the running of the machine whether the proportions and the construction as a whole are perfect or imperfect. If the machine will run without sparking, or at least with only very small sparks, when the load is varied within wide limits, it may be assumed that the proportions are good and the construction perfect, except in so far as the width of the insulation between the commutator sections is concerned, and this can only be determined by actual use; although many of those who have had considerable experience with electrical machinery can judge very closely from the appearance. If the insulation is too wide, it will not wear away as fast as the sections, and on this account the commutator will not run without sparking unless it is smoothed up with sandpaper every few days. As a guide to those who have not had sufficient experience to be able to judge by appearances, it may be said that if the insulation is more than four-hundredths of an inch thick trouble of this kind may be expected.

In many cases the commutators will spark on account of the number of sections being too small, but this is not likely to be the case with two-pole machines, as with these there is no occasion for reducing the number below the proper limit. With the multipolar type, which is now universally used for large machines, the case is different. In consequence of the greater number of poles the commutator has to be increased in size, as the number of sections corresponding to each pair of poles should be the same as in the two-pole machines, but some manufacturers, in order to reduce the diameter of the commutator, cut down the number of sections to the very lowest point, and in some cases go even further than this, and as a result the sparking becomes very pronounced.

The wear of the commutator is caused mainly by the sparking, and as this cannot be wholly eliminated, it follows that the sections should be made of considerable depth, so that they may not have to be replaced very soon. If the construction of the commutator is such that the ends of the sections are exposed, the amount of available wear can at once be seen, but in most cases the construction is such that the ends are partially if not wholly covered. If there is a ring on the end to hold the sections in place, and the latter project above it, the proper inference to draw is that the sections are deeper than would be the case if they were even with the end ring. But this is not always so, because some manufacturers make the end ring of the same diameter as the body of the commutator so as to hold the sections more firmly. The latter construction, however, is very defective, and, under certain conditions, may cause serious damage. The armature shaft is generally given some end play, so that the commutator, as well as the journal bearings, may be kept from wearing into grooves, as the transverse motion will prevent this. Now if the end play becomes too great, from any cause, which is possible, and has happened in many cases, the brushes will ride over on to the end ring, and thus cause a short-circuit, and in all probability do serious damage. For this reason, if no other, commutators with the end ring of the same diameter as the body should not be used.

The next important point to investigate is the construction of the brush holders, and the kind of brushes used. As to the latter it may be said that the only kinds that should be considered are the carbon and the woven wire. The carbon brushes, all things considered, are the most desirable; they work as well as the woven wire and are very much cheaper; but in some cases the latter give the best results, and although they cost many times more than the former they last so long that the difference in price should not be taken into consideration when their use reduces the sparking.

The type of brush holder will depend, largely, upon the kind of brush. For carbon, either the inclined or the radial may be used, but with woven wire brushes the inclined holder is the only one that will answer the purpose. The radial holder is the best, as it prevents the circumferential displacement of the brushes. With the inclined holders, if one brush wears faster than the other it will rest on the surface of the commutator at a steeper angle, and, therefore, will be out of position, and as a result will spark. The brushes should divide the circumference of the commutator equally; thus, if there are two, they should be diametrically opposite; if there are four, they should be 90 degrees apart; and for six they should be 60 degrees apart. As the brush holders are equally spaced, it follows that unless the angle at which the brushes rest upon the surface of the commutator is the same for all, some of them will be out of place. The inclined brush holders are so made that they swivel upon a stud, and thus maintain the contact between the brush and the commutator as the end of the former wears away. In order to overcome this defect these holders have, in some cases, been made so that they cannot swivel, and the wear has been compensated for by feeding the brush endwise; but this is not a good construction, as the dragging action of the commutator is almost sure to draw the brush through the holder so far as to make the pressure greatly in excess of what it should be, and in some cases may even wedge the brushes so tight as to do damage. The radial holders obviate all this trouble, as they feed the brushes in a line toward the centre, and, therefore, cannot get out of place when they wear away, and the pressure cannot become too great. In the majority of the machines now made there is very little difficulty with the field coils, but it is always well to see that they are of such construction as to make it evident that they will not give trouble. As the effect of the current is to heat the wire, it is evident that the coils that are spread out the most will heat the least, as they will have more surface from which to radiate; therefore, long coils, upon which the wire is not wound very deep, are more desirable than those that are short and with a greater depth of wire.

As the oil from the shaft bearings is full of metallic particles, it is very liable to injure the insulation of the field coils if it gets upon them, especially as it will accumulate, in addition to its own impurities, dust and dirt of every kind; therefore the location of the coils should be such that they may remain as clean as possible. The wire wound on these coils is very small and frail except on large machines, and on this account the ends should not be secured in such a way that they can move, for if they can it will not be very long before they will break or chafe the insulation to such an extent as to cause a short-circuit. These ends should be fastened to strong binding posts and from these the connections to the brush holders or the switchboard, as the case may be, should be led.

It is generally believed that the coils should be protected by a substantial covering, so that they may not be damaged by being struck by anything in an accidental way; but experience has shown that this precaution is not of any great benefit, and machines with unprotected coils stand just about as well as those that are protected the best.

In former days the shaft and bearings were in many cases entirely too small to work well, but these are very seldom points of weakness in modern machines. In the early days, small shafts were used so as to make it apt as to whether the oiling arrangements are good. There are very few makers, at the present time, who do not use self-oiling journals, but these devices are not always reliable, and therefore should be thoroughly examined, as, in some machines, they may be worse than useless. Any man who is a mechanical expert can tell whether these parts are defective or not, and also whether the shaft is of proper size.

There are many points, besides those here considered, that determine the merits of a machine, but to consider them all would be impossible in an article of this size. Those that have been discussed in the foregoing, however, are the most important ones, and a machine that is not defective in these may be depended upon to give good service.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1896.

[*Compiled expressly for this journal by* W. P. Thompson & Co. *Electrical Patent Agents, 322, High Holborn, London, W.C., to whom all inquiries should be addressed.*]

23,127. "Improvements in or in connection with arc lamps." F. M. Lewis. Dated October 19th. (*Complete.*)

23,161. "Improved electric lamp advertisement attachment." E. A. Ingold. Dated October 19th.

23,178. "Apparatus for varying the speed of electromotors." C. D. Abel. (Berliner Maschinenbau-Actien Gesellschaft vormals, L. Schwartz Kopff, Germany.) Dated October 19th.

23,180. "Improvements in or connected with means or apparatus for producing light by electricity." C. H. Stearn. Dated October 19th.

23,194. "Improvements in nitrated fabrics for electrical and other purposes." C. Hoepfner. Dated October 19th.

23,195. "Improvements in machines for weaving insulating coverings on electrical conductors. H. H. Lake. (Augustus T. Clark, United States). Dated October 19th. (*Complete.*)

23,242. "Improvements in and relating to electric incandescence lamps." F. W. Dunlop and J. R. Quain. Dated October 20th.

23,249. "An improved insulator." J. H. Cottingham. Dated October 19th.

23,256. "Improvements in electric lighting for velocipedes, cabs, broughams, omnibuses, tramcars, or any other vehicle, and in the method of generating and storing electrical energy therefor by the utilisation of the motive power of the said velocipedes, cabs, broughams, omnibuses, tramcars, or any other vehicle." A. M. Armstrong. Dated October 20th.

23,258. "Improvements in primary electric batteries." J. E. Preston. Dated October 20th.

23,282. "An improved method of and arrangements for illumination by means of incandescent electric lamps. P. C. E. Champion. Dated October 20th.

23,291. "Improvements in or relating to trolleys for overhead systems of electric traction. The British Thomson-Houston Company, Limited. (Norman C. Bassett, United States.) Dated October 20th. (*Complete*).

23,315. "Improvements in electrical apparatus for controlling traffic on single lines of railways." J. P. O'Donnel. (J. W. Wainwright Hopkins, Argentine Republic.) Dated October 20th. (*Complete.*)

23,334. "Displacing prices and the like in shop windows and other places by electric illumination." J. R. Craig, jun. Dated October 21st.

23,339. "Phil. Phillips's electric mat and cushion." P. Phillips. Dated October 21st.

23,352. "Improvements in electric sparking apparatus for ignition purposes in oil and gas motors and the like." E. W. Lancaster. Dated October 21st.

23,374. "The tubular switch." J. D. Palmer. Dated October 21st.

23,393. "Improved portable telephone apparatus." J. Kandt. (The firm of Topffer & Schadel, Germany.) Dated October 21st. (*Complete.*)

23,399. "Improvements in electric switches." H. F. Kleinschmidt. Dated October 21st.

23,474. "A new or improved method of an apparatus for electrically lighting cycles and other vehicles." H. Torkington. Dated October 22nd.

23,497. "Improvements in means or appliances for facilitating the drawing of electric conductors through tubes or conduits." H. Edmunds. Dated October 22nd.

23,512. "Improvements in electricity meters for alternating currents." G. Hookman. Dated October 22nd.

23,519. "Improvements in bonds for electrical railways." (F. T. Newbury, United States.) Dated October 22nd.

23,531. "A combined reflector and fastener for electric lamps." F. W. Allen. Dated October 23rd.

23,545. "Apparatus for controlling incandescence electric lamps when connected in series." J. Dugdill. Dated October 23rd.

23,556. "An improved electrical wire joint or connection." J. Brembridge-Melhuish. Dated October 23rd.

23,587. "An improved electric alternating current machine." J. J. A. Minder and S. Appel. Dated October 23rd.

23,663. "New and useful improvements in the apparatus for the production of oxygen and hydrogen by electrolysis (system Garruti)." P. Garbuti and R. Pompili. Dated October 24th. (*Complete.*)

23,665. "Improvements in telephone transmitter." W. A. Moore. (Date applied for under Patents, &c., Act 1883, Sec. 103, March 25th, 1896, being date of application in United States.) Dated October 24th. (*Complete.*)

23,698. "Improvements in and relating to electrical governors." P. W. Northley. Dated October 24th.

23,705. "An improved form of contact blades for switches for electrical purposes." F. W. Heaton and H. Smith. Dated October 24th.

23,706. "Improved high insulating tumbler switch." F. W. Heaton and H. Smith. Dated October 24th.

EXPIRING PATENTS.—1882.

We are informed by Messrs. W. P. Thompson & Co. that about 70 applications for electrical patents were filed in the month of November, 1882. Only two of the patents of these applications have been maintained for their full term, and as they are of considerable interest we give short abstracts of them below:—

5,315. "Insulating compounds and processes for the insulation of electric conducting wires and cables." J. Wetter. (R. S. Waring and J. Burrows Hyde, United States.) Dated November 7th, 1882. This invention consists in enveloping the wires in an arming of fibrous material, cotton threads for instance. This wound wire is then subjected to heat to drive off all moisture; the heat exceeds 212° Fahr. Immediately afterwards the covered wire is conveyed to a bath containing insulating materials. Or the covered wires may be coiled on reels and immersed in the insulation bath heated to a considerable degree above the boiling point of water. The saturated wire is unwound from the reels through a space to effect sufficient cooling. Or the coils of the wires may be enclosed in drying chambers. According to another plan, when all moisture is expelled from the fibrous coating of the wires they may be enclosed air-tight in a casing of lead. The insulating medium contains the liquid distillates of petroleum combined with resinous or bituminous substances; these distillates may be combined, when needed, with clay, pulp, &c. The heavier distillates may be used. In manufacturing cables the wires pass out of the apparatus simultaneously with the lead covering as a complete cable. 14 claims.

5,509. "Production of magnesium, aluminium, and other metals of the alkaline earths." L. A. Grotz. (R. Gratzer, Germany.) Dated November 20th, 1882. The chloride or fluoride of the metal required is melted and electrolytically decomposed in a crucible or melting vessel or chamber, which may be made of metal and which, being connected to the negative pole of a dynamo-electric machine, serves as the negative electrode. Melting vessels made of graphite, fire-clay, or porcelain may have suitably shaped metallic projections for negative electrodes. The vessel has a cover through which the positive electrode is introduced. The invention includes the simultaneous employment of reducing gases, which can be best introduced and conducted through the closing lid from above or the gas may be introduced at the side of the vessel if preferred. 3 claims.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Copies of any of these Specifications may be obtained of* Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., *price, post free,* 8½*d.* (*in stamps*).]

1895.

8,696. "Improvements in electric distribution and apparatus in connection therewith." A. Wright and R. C. Quin. Dated May 2nd, 1895. Relates to systems of distribution in which continuous currents are supplied at one time and alternating at other times. The switches are provided with locking devices so arranged that the alternating current cannot be switched on whilst the continuous is on. The locks may be operated by electrical or other means. 2 claims.

9,372. "An electric oven." V. G. Middleton and D. Neale. Dated May 11th, 1895. The oven is formed in two parts, the upper part being raised vertically to expose the contents. This upper part suitably jacketed with insulating material is supported in a framework and counterbalanced to render it easily movable. The lower part carries a frame fitted with ledges for carrying shelves. The oven is heated by incandescent lamps arranged in parallel each having a separate switch. 3 claims.

10,746. "Improvements in or relating to the connecting and disconnecting the sockets of incandescent electric lamps." P. Benham and W. Smith. Dated May 30th, 1895. Relates to holders of incandescent lamps to facilitate the attachment and removal of a lamp shade, the lampholder is provided with a nut for clamping the shade holder against the collar. The nut is provided with lugs which engage with the jaws of a pair of tongs, or with recesses in a skeleton box spanner used for fixing the nut. 4 claims.

10,895. "An improved electric light standard for workshops and the like." G. Stegmann. Dated June 1st, 1895. Relates to an adjustable standard for an incandescent electric lamp specially applicable for workshop or laboratory use. A hollow column carries a sliding rod which may be secured in any required position by a set screw. The upper end of the rod carries between spring jaws an adjustable socket in which a rod carrying the lampholder, reflector, &c., can slide, the whole being secured together by means of a set screw. In a modification the socket may be open at the top to permit of the insertion of the tube which is secured by a loose piece pressed against it by a thumb screw. 3 claims.

1896.

16,790. "Telegraph wire reel." H. Ehricht. Dated July 29th, 1896. Relates to telegraph wire reels, and consists of a cross stand upon which a cross running on rollers turns, the rollers running upon a ring placed on the cross stand. The cross has on each of its arms a groove in which the wire rollers slide, being fastened by a butterfly nut in order to firmly hold the wire coils of various sizes. 2 claims.

17,123. "Improvements in insulating joints for metal or armoured conduit tubes, more especially suitable for electric conductors." H. H. Lake. (E. S. Greenfield, United States.) Dated August 1st, 1896. Relates to a joint for two armoured conduit tubes, consisting of a collar surrounding a short tube or thimble of insulating material, having V-shaped grooves at its opposite ends. Said collar and armoured conduit tubes are provided with means for connecting them firmly together under pressure, so that the thimble and the lining of the conduit tubes constitute one continuous insulating tube. 1 claim.

17,125. "Improvements in conduit tubes more especially suitable for electrical conductors." H. H. Lake. (E. S. Greenfield, United States.) Dated August 1st, 1896. Relates to armoured conduit tubes composed of an iron armour, and an insulating lining preferably of paper treated with liquid ashphalt, paraffin, &c., which will liquefy under abnormally high temperatures; this insulated lining is also lined with a metallic non-fusible, non-combustible lining, preferably of thin sheet-iron, which does not liquefy under such temperatures as are found near steam pipes, flues, hot air shafts, &c., where these tubes are intended to be located. When this metallic lining is of iron the ends are separated at the joints by definite spaces, so as to overcome the inductive effect upon the enclosed conductors in the system in which such conduit tubes are used. 3 claims.